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SOME SCIENTIFIC ASPECTS OF ORTHOPAEDIC SURGERY

*Presidential Address**

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At the outset I must ask your indulgence if I seem to make particular reference to American work, and occasionally to methods which I have attempted from time to time to set before the profession. Each of us must test truth by his own experience, and criticism is generally more or less valid as it originates closer to or more remote from one's own observation. My argument may gain your approval if supported by a weighty reference, but not if it runs counter to your experience; my own experience must have similar weight with me.

Orthopaedic surgery is the last outpost to be established by the specialist; and I make no apology to the general practitioner in speaking of the spread of the light in dark places. Sir Robert Jones is not the only one to confess to an attitude of pessimism concerning the treatment of fractures, or orthopaedic conditions, by the general practitioner or general surgeon.

No orthopaedic surgeon can deny that correction of distortion depends largely on mechanical laws. Muscle pull and leverage can be reduced to terms of physics. Reparative processes in bones are aided by exact reposition; and the principles of cabinet-making are applicable to orthopaedic surgery. Good mechanics aids repair only when combined with good biology; and sound biological principles can only be applied with due consideration for the principles of mechanics when such a rigid tissue as bone is being aided to repair itself. Such are the resources of nature that repair will proceed in the face of adverse conditions, provided there is a balance of favorable conditions.

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Certain operations on bones are sound neither mechanically nor biologically. Methods of fusing certain joints by chip grafts fall in this category. If osteogenetic power is high, the operation may succeed; if not, it will fail. The osteogenetic potential of a bone cannot be determined in advance; it does not vary directly with such measurable factors as the youth, robustness, or general health of the patient. It is a wise prevision to assume a minimal osteogenetic power and to plan the operation on that assumption. I have seen numbers of cases in which not one out of many chips was found united.

Although such methods as these are assailable on scientific grounds, the results obtained by them have encouraged many surgeons to use them. They are important stepping stones in orthopaedic surgery. As we become better trained mechanically, and acquire a better understanding of the biological principles of the growth and healing of bone, we shall not be satisfied with methods that can be questioned on either mechanical or biological grounds; and we shall not be tempted to follow the few into unsound practices.

When new science touches our practice, we can test its truth by applying it to the human patient. The world is coming to a more general agreement not only that this is practical scientific medicine, but that it may be the most exact medical science. To a man of investigative mind, every patient is part of an experiment which nature is laying out before his eyes, and every step in an operation is part of an experiment which he and nature are conducting together.

The information one acquires and the observations one makes in related sciences, are of the greatest importance in the development of orthopaedic surgery. I have had to turn to many sources of knowledge in the work in which I have been particularly interested. I shall have time to indicate only the more general dependence of orthopaedic surgery on the fundamental sciences and on other branches of medical science.

RELATION TO BOTANY

There is a remarkable analogy between grafting processes in the vegetable kingdom and grafting in surgery. The vegetable kingdom shows less differentiation of tissue than the animal kingdom, so that the range of compatibility is wider when plant tissue is grafted than when that of animals, and especially of man, is grafted. Plant grafts will take if the host and scion belong to related varieties. This is not the case in animals, and especially in man, where autogenous grafts are almost necessary. In man, the less highly differentiated tissues graft better. Fascia, tendon, and bone present a much simpler problem than nerve tissue, for example, which cannot be grafted, in the strict sense, at all.

In both animals and plants it is desirable to have corresponding layers, if possible, placed in contact and held there by accuracy of fit and by immobilizing measures. In the plant the double-bladed grafting knife

insures accuracy of fit of scion, bud, bark, and alburnum. In the case of the human osseous system, the same precision can be attained only with motor-driven tools, since the material to be cut is so much harder. Immobilization is brought about in the plant by accuracy of fit and by the paraffin dressing which, by protecting the healing zone against saprophytes and fungi, takes the place of aseptic technique in the grafting of bone and, by allowing almost the entire spectrum to penetrate, brings to the chlorophyl of the healing tissues of the plant all the advantages that we seek by heliotherapy.

RELATION TO EMBRYOLOGY

Embryology serves as a guide to the orthopaedic surgeon particularly in the selection of the source of the bony transplant for fusion of the spine. There are two sources generally considered: local bone in the form of chips, and bone of higher osteogenetic power taken *en masse* from a long bone. The long bones are derived from the mesoderm, that source of less highly differentiated tissue. The vertebrae, particularly their processes, arise from the ectoderm which gives rise, generally, to more highly differentiated tissue. It is to be expected, then, that tissue originating from the more highly differentiated embryonic layer will withstand alteration of environment less vigorously and will manifest a less robust osteogenetic power than that derived from the less highly differentiated mesoblastic layer. This, indeed, is just what is observed by surgeons generally. Fractures of the lateral and spinous processes rarely unite; fracture of the body usually throws out little callus; trauma may cause progressive absorption of the body as observed in Kümmel's disease; tuberculosis causes the affected vertebral body to melt away with little or no evidence of repair by osteogenesis. It may be that the paucity of callus in the vertebrae is part of nature's plan and intended to obviate pressure on the contents of the spinal canal (by excessive callus). The lesson from embryology, reenforced by surgical experience, is that mesoblastic (long) bone offers a better source for grafts.

RELATION TO PHYSIOLOGY

The simplest explanation of the phenomena following the grafting of one bone into another by accurate technique, is that the vascular system of the two unite by budding and canalizing of capillaries. In short, it is union by first intention. When an inlay bone graft is inserted into two bones, it furnishes a vascular bridge by which the circulation is conducted between these host fragments; the graft also receives its own nourishment by means of this linking up of vascular systems. Inasmuch as seventy-five per cent. of the blood supply to cortical bone comes to it via the marrow, and vascularization precedes osteogenesis, it is apparent that, if possible, the graft should be brought into contact with this part of the osseous system.

From this conception of the physiological principles of grafting arises the necessity for accurate motor-driven tools capable of cutting bone with precision, so that the vascular bridge that forms the basis of union can be established as quickly as possible. The surgeon should put himself in the place of the cabinet-maker who finds himself with a scanty supply of glue. He must make up for the deficiency by greater care with the fitting of his joints, so that there will be no crevices to take up his glue. Indeed the cabinet-maker like the surgeon will get a firmer union in just this way.

This is quite in contrast with the conditions attending inaccurately fitting grafts such as the shaft of the fibula in a drill-hole, or chip grafts used to fuse the spine and other joints. In such procedures, the vascular conditions are unfavorable; there is extensive organization of blood clot at the zone of bone repair; and the burden upon osteogenesis is consequently very great.

RELATION TO GENERAL MEDICINE

The tendency toward detachment which has been so severely criticized in the development of specialism should be less evident in orthopaedic surgery than in most specialties.

As every specialty should, this, too, merges into medicine when one looks at the patient generally in order to estimate what factors, both physical and psychic, he may contribute to his own cure. Long confinement to bed increases the surgical risk more than most surgeons realize, even when there is no tangible evidence of lowered vitality, such as general debility, loss of weight, or anaemia. In the case of a reasonably robust girl of seventeen, who had been confined to bed for six months by an ununited fracture of the neck of the femur, I was unable to get any farther than drilling the hole through the fragments, so profound was the reaction to the trauma. In ambulatory patients, even though elderly, I have had no such difficulty.

Shock—There are many elements that contribute to shock, some inherent in the constitution of the patient, some dependent on the conduct of the operation. Cannon and Turck taught a splendid practical lesson when they demonstrated the shock effect produced by the destruction of soft tissue, and the absorption of tissue juices into the circulation. The effect is presumably produced by histamin or related substances. We know that blunt dissection, resulting in destruction of soft tissue, and prolonged forcible retraction tend to produce shock, by forcing the products from traumatized tissue into the capillaries and thence into the general circulation. Thus temerity may lead to trouble, as it so often does in surgery. If the femur is to be exposed, it is better to approach by means of a clean cut through the muscles than by blunt dissection. The trauma caused by prolonged tearing and squeezing of tissues can cause a much more severe reaction than the loss of blood if hemostasis is given reasonable care. Dull instruments are a menace. I find the interchangeable blade the best means of insuring sharpness of scalpel. Again, the timorous

surgeon who fails to provide a large enough incision invites rather than escapes the danger of shock when he uses a strong-armed assistant to subject the tissues to prolonged pressure with a retractor.

Shock may be avoided by using suitable methods of cutting bone. It is well known that the shock of a high-velocity bullet is almost negligible. The wounded man walks quite a distance and is sometimes stopped only by the sensation of trickling blood. A spent bullet or shell fragment may produce great shock; the soldier, even though not badly wounded, may drop in his tracks. Sensory nerves have a wide range of excitability, varying in different animals. If the object which severs nerves is moving rapidly enough, the nerve will not be excited by the trauma.

The same principle applies to the use of the motor saw which, making 4000 revolutions per minute, produces little or no stimulation of the afferent nerves and hence no shock. This principle is therefore a step beyond Crile's anoci-association which intercepts afferent impulses by nerve block; the motor saw may prevent their inception.

Blood Transfusion.—In operations on the bones there is more call for the transfusion of blood than in general surgery. Blood is particularly necessary in building up bone; there must be no anaemia and no localized ischaemia. There is a stage in the union of bone where abundant supply of healthy blood is essential, and the entire process of healing is more rapid and more satisfactory if there is no dearth of nutrition to the zone of repair. Blood transfusion is better given before than after operation. The importance of local ischaemia as a cause of non-union is illustrated by several cases in which healing of the soft tissues after compound fracture left an anaemic scar with failure of bony union. The preliminary step was an operation to replace this ill nourished tissue with a pedicled flap of skin and subcutaneous tissue from the other extremity, well supplied with blood. When, by this means, vigorous circulation was established in the vicinity of the ununited bones, they began to throw out callus and in due course union was solid without any need for the plastic bone operation which had been planned. There could be no better demonstration of the dependence of osteogenesis on blood supply.

These considerations have to do particularly with operative orthopaedics in its relation to medicine. Diagnosis and etiology are still more dependent on medicine.

If we are ever to discover the causes of the chronic changes in bones and joints, it will be by a better understanding of the relationship of bone growth and bone disease to the endocrine system, to general metabolism, to the chemical state of the blood, and to focal infection.

The Endocrine System.—While knowledge of the endocrine system is still in its infancy and presents many confusing aspects, we have been able to profit materially from the discoveries that have been made. The relationship of normal bone growth to the activity of the thymus and sex glands still challenges explanation. The pathological changes in the pituitary gland in acromegaly and pseudohypertrophic muscular dystrophy

illustrate how dependent development is on that gland. Gigantism, dwarfism, and the stunting of cretinism reflect the response of bone growth to disturbances of its thyropituitary control. To add to the interest of the problem is the known effect of the parathyroids on the mobilization of calcium.

We have made an attempt to apply some of this knowledge to diseases and disorders of bone. In some cases, parathyroid extract has stimulated the formation of callus; thymus extract has been used with some success in the treatment of arthritis. In my own experience these methods have been successful often enough to justify their continuance. Their status is about that of vaccines: we hope for more than we expect.

Blood Chemistry.—The study of the calcium-phosphorus content of the blood in non-union appears to have been a disappointment, but I am convinced that further investigation will eventually show a relationship between the two, at least in certain stages of non-union. By the time the chemical disturbance is corrected, some secondary cause may be operative.

Food and Vitamins.—The problem of diet is not becoming generally any simpler, and a good part of the discoveries of one year relate to the errors we made the year before. When we come to the vitamins we are on sounder ground. We seem to know more about the effect of these obscure intangible principles than we do about that of the foods and minerals we have known since science began.

Ultraviolet Rays.—More recent study has shown a link between vitamins and a purely physical force, the ultraviolet ray. The work of Hess on irradiated foods gave an added reason for the value of heliotherapy, the benefits of which, particularly in the treatment of surgical tuberculosis, are becoming more evident every year. The energy from the ultraviolet end of the spectrum, at least, must act like a vitamin. In fact, since it has little power of penetration as a ray, it must influence metabolism mainly as a vitamin. Although entirely inert prior to irradiation, certain sterols become so activated by exposure to ultraviolet that one ounce equals in vitamin content five tons of cod-liver oil. Flour and dried milk can also be activated by ultraviolet, and the latter retains its potency for three months. Thus far such foods have not been put on the market, but it needs no imagination to grasp their health-giving possibilities. We should compliment ourselves that we are catching up to empirical therapeutics: we know why we prescribe cod-liver oil and have a clearer idea of how sunshine helps to nourish and restore the debilitated organism.

Like every other new thing, ultraviolet will be carried to extremes and too much will be expected of it. Due cognizance has not been taken of the effect of the seasons and of atmospheric conditions on the shorter waves of the spectrum. In the temperate zone the amount of ultraviolet in winter time has been estimated at as little as five per cent. of its summer peak. Fog, smoke, and dust are known to absorb it. A recent investigation of the New York City atmosphere has shown that there are 4200

tons of foreign substances in the air over the city. The dust particles in one cubic inch of air in any large city, such as London or New York, if arranged end to end, would measure seven and one-half inches. Other studies have been made of the amount of ultraviolet that penetrates foggy atmospheres. They all go to show that for many months the ultraviolet rays are negligible in most large cities, and that on foggy days the ultraviolet has been absorbed before the light reaches a window or a human being. Since becoming President of the American Orthopaedic Association, I have been inundated with literature referring to ultraviolet-transmitting substances. I would not wish to minimize the value of window glass and glass substitutes permeable to ultraviolet, but such substances cannot manufacture the ray or transmit what is not present. The problem is to conserve ultraviolet by correcting those conditions which destroy it.

Hill's work, however, would indicate that the presence of bodies of water or snow fields magnifies the value of the ultraviolet present, since both water and snow reflect these rays.

Economics and Health.—We know the relationship of lack of vitamins to such diseases as scurvy and rickets, and we believe that the tendency to tuberculosis is increased by lack of sunlight (especially ultraviolet) and lack of vitamins. In northern lands, especially if the percentage of sunshine is low, such diseases constitute a difficult problem. Destruction of tuberculous cattle may be too expensive if the disease is rife; pasteurization of milk will reduce its vitamin content.

What effect the destruction of the tuberculous herds has on the incidence of tuberculosis in human beings is demonstrated in countries where these heroic measures have been taken. Twenty-five years ago, when I began to have a hospital service, surgical tuberculosis was very common and very sad. Now it is no exaggeration to say that it has almost disappeared. In its place, with the great increase in industrial activity, and in the speed and stress of life, we have the traumatic cases.

In some lands surgical tuberculosis has disappeared less rapidly. I have been referring to conditions in my own country. One often hears Americans say that we do not know how to live. Whatever the truth of that is, I can be sure we are learning how to exist. We believe that our poorer classes are getting better and more abundant food. Even out of season they have a supply of green vegetables, provided by a system of efficient refrigeration transportation which is now carried out on such a large scale that its cost to the individual is almost negligible.

In northern countries the prevalence of bone and joint tuberculosis has seemed unduly high. In traveling through such lands, I have tried to discern what causes might be still active that are not evident farther south. It is undoubtedly true that the long season of scanty sunshine is one of the causes, although it is more or less compensated by the long days in summer. More important still, in my opinion, is the absence of facilities for storing summer sunshine for winter use, or for importing sunshine from sunnier lands in winter. In other words, green vegetables

are available only during the sunny season when they are not so vitally necessary. Instead of fresh meat, fish, and vegetables, the staple diet is salt fish and cured meat, often highly palatable but deficient in vitamins and even in nutritive value.

Much of the reduction in both tuberculosis and rickets is attributable to the general interest in health, as evidenced by the large amount of space in newspapers and magazines and the considerable amount of radio time devoted to lessons in health and diet. Interest has centered mainly about diet and vitamins; fresh vegetables and milk.

RELATION TO BACTERIOLOGY

The Orr Treatment.—The discoveries in bacteriology have been of the greatest value in orthopaedics. The Orr treatment of osteomyelitis was, as I believe, an unintentional application of the principle of the bacteriophage or some allied phenomenon. Although there is a great deal in Orr's contention concerning the importance of avoiding secondary infection, I am convinced that his method allows the bacteriophage to develop in the wound.

Extensive bacteriological investigations have been made on my cases for some months. The results are not yet complete, but so far lysis of bacteria, transmutation, lowering of virulence, and change of flora have been observed in smears and cultures from the wound. This is sufficient to show that there is something in the wound which has a profound influence on both vegetative and reproductive activities of bacteria as well as on the configuration of the antigen. The lysis is, of course, suggestive of the presence of the bacteriophage as described by d'Herelle. The other phenomena have been attributed to the bacteriophage by other bacteriologists.

The Orr treatment excels in most respects all others, not even excluding the Carrel-Dakin. It has two outstanding advantages: immobilization dressings can be maintained for weeks without interruption or interference; the patient can live at home, returning to the hospital at intervals of about eight weeks for reapplication of dressings and cast. The advantages to surgeon, patient, and family—particularly the financial advantage—are so obvious that the surgeon must choose the Orr method as soon as he learns its clinical value.

Myofasciitis.—There is little unanimity concerning the chronic infections of joints. Whether the infection or circulatory changes come first, whether the changes are infective or toxic or metabolic, certain clinical facts are indisputable; these concern the relationship of the arthritic manifestations to focal infection. Not only in the joints but in the surrounding structures, especially the attachments of muscle tendons, ligaments, and fascia, is the effect of focal infection and toxic absorption to be observed. Many of the painful disturbances in the lower back have, I am convinced, been erroneously attributed to anatomical disturbances.

So called sacro-iliac relaxation has rarely been demonstrated anatomically. I am confident that immobilizing operations are usually unnecessary, because the cause can be sought in focal infection, and the irritation of soft tissues (whether by infection or toxins) stopped.

Focal infection has been commonly found in teeth, tonsils, sinuses, gall-bladder, and generative organs in both sexes. The colon has been commonly overlooked as a focus of toxic absorption. I would put it at the head of the list. To this inflammatory state of muscle insertions and fascia I apply the term "myofasciitis." As a clinical entity it has served to clear up heretofore misunderstood clinical conditions. I believe that a very large percentage of the following diagnosed conditions are fundamentally cases of myofasciitis:

Relaxation or strain of the sacro-iliac joint
Lumbago
Sciatica
Sciatic scoliosis
Weak foot or pes planus (particularly the clinical type with short tendo Achillis).
Infectious torticollis
Tennis elbow

Bacteriology of the Colon.—Some interesting results have been obtained from the investigation of the bacteriology of the colon in these cases of myofasciitis. As the bacterial content of the colon varies, the products of intestinal putrefaction change; the toxicity of substances absorbed from the large intestine thus depends to some extent on the particular bacterial strains present. Histamin may or may not be important as a toxic product, but its concentration serves as an excellent index of the toxicity of the contents of the colon. Hence the value of colonic irrigation when there is any reason to believe that periarticular inflammatory changes are toxic in origin.

Orthopaedic and colonic treatment are so important and should be coordinated over so long a time, that the orthopaedic surgeon would do well to include in his armamentarium means for carrying on irrigation of the colon in his own office. That has been my practice for some years with a great deal of satisfaction. It should be remembered that irrigation to be effective, should reach all parts of the colon. The two-way method commonly employed, which reaches only a few square inches, is of little value.

CONCLUSIONS

The consideration of these problems in the cause, nature, and treatment of orthopaedic conditions makes it clear why this specialty should maintain the closest contact with the fundamental sciences. This is salutary, for disaster awaits isolation. There are two trends in medicine: one to divide its growing mass into specialties, the other to seek through the whole interrelated system of functions for the cause of disturbance of any one

function. If the practice of orthopaedic surgery demands special aptitude and special training, the specialty escapes the dangers of too circumscribed an outlook by insisting upon a close acquaintance with the fundamental sciences. It thus contains its salvation in its own fabric. To discover its secrets, you must search widely; to practise it honestly and effectively, you must call upon all of man's skill and wisdom that you can turn to your purpose.

EXPERIMENTAL ARTHRITIS

The Reactions of Joints to Mild Irritants*

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The observations presented below are part of an attempt to determine the manner in which joints react to various types of injuries. This paper contains observations on the exudates and descriptions of the histological changes produced in the joints of normal rabbits by the injection of certain foreign materials into the joint cavity. The materials used were citrated blood and India ink (carbon particles).

MATERIAL AND METHODS

The animals used were normal adult rabbits. In making the injections the animals were lightly anaesthetized with ether and the skin over the knee was wet with alcohol. A hypodermic syringe was then thrust through the skin and into the space between the patella and the femur, and the material was injected directly into the joint cavity. The rabbit's knee holds from one and a half to two cubic centimeters of fluid. The blood used was aspirated into sterile sodium-citrate solution from the heart of one of the rabbits used in the experiment. The India ink was a fifty-per-cent. solution of Higgin's American India ink, which had been filtered to remove the larger particles and then sterilized by boiling.

Three series of rabbits were used: in the first, each received a single injection of blood; in the second, each received seven injections of blood over a period of three weeks; and in the third series, each knee joint received a single injection of India ink. The observations include the changes occurring during a twelve-day period, and one joint was studied on each of twelve successive days after the injection.

For study the animals were anaesthetized with urethan and samples of the exudate were withdrawn in fine glass pipettes. The fluid was placed on prepared slides, and the cells stained supravitally with neutral red and Janus green, and the preparations were examined in a warm box in a manner similar to that used in studies upon normal synovial fluids[1].

After the observations on the exudates had been completed, the animals were given lethal ether, and the joints were excised and opened for inspection and further vital studies on the scrapings from the synovial membrane were made. The joints were then fixed in formalin or Zenker's fluid. After the dehydration most of the joints were dissected, the soft

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parts being removed from the bone to permit sectioning without decalcifying. In certain instances the joints were decalcified and sections of the bone were made. All tissues were imbedded in paraffin and sections cut at five microns. Hematoxylin and eosin were used for routine study and in some instances sections were stained for connective tissue or mitochondria.

SYNOVIAL EXUDATES FOLLOWING A SINGLE INJECTION OF CITRATED BLOOD

On the day after the injection of the blood, the knee joint was distended with a dark red glairy fluid. Not only was the blood present in the joint, but it had passed along the sheath of the tibialis anticus muscle to the lower third of the leg. There was also a moderate amount of blood in the capsule and subcutaneous tissues at the site of the injection. On the succeeding days the amount of fluid in the joints was progressively less, until on the fourth day after the injection there was practically no excess fluid in the joint, and the small amount of clear fluid present appeared normal on gross examination. The extravasated blood in the tissues at the site of the puncture and in the lower part of the leg around the tibialis anticus muscle persisted much longer and had not entirely disappeared at the end of twelve days.

Microscopic studies of the joint fluids showed that the red blood cells were present in great numbers on the first and second days after the injection. On the succeeding days, the number of red cells decreased rapidly until by the fifth day after the injection the number present was not much in excess of that found in normal joint fluid. In addition to the red cells, there was a variable number of nucleated cells present in the fluids.

The nucleated cells were most abundant on the first two days after the injection of the blood, when twenty or more could be counted in a single oil-immersion field. After this time their number decreased gradually until at the end of the twelve-day period they were only about five times as numerous as in the normal joint fluid. In the supravitally stained preparations they could be classified as leucocytes, synovial membrane cells, and cells of the macrophage group (monocytes, clasmatocytes, indeterminate macrophages, and primitive cells).

In studying the exudates it has seemed proper to consider these cells in three separate groups: (1) leucocytes, (2) cells of the macrophage series, and (3) synovial membrane cells.

The percentage of the nucleated cells which were leucocytes is given in Chart 1. It is seen that on the day after the injection, when there was a large excess of highly cellular fluid, ninety per cent. of the nucleated cells were leucocytes. On the second day they comprised seventy-two per cent. of the nucleated cells. After this time as the fluid decreased in amount, they rapidly disappeared from the joint until on the fourth day the proportion of polymorphonuclears was within normal limits (not over ten per cent.).

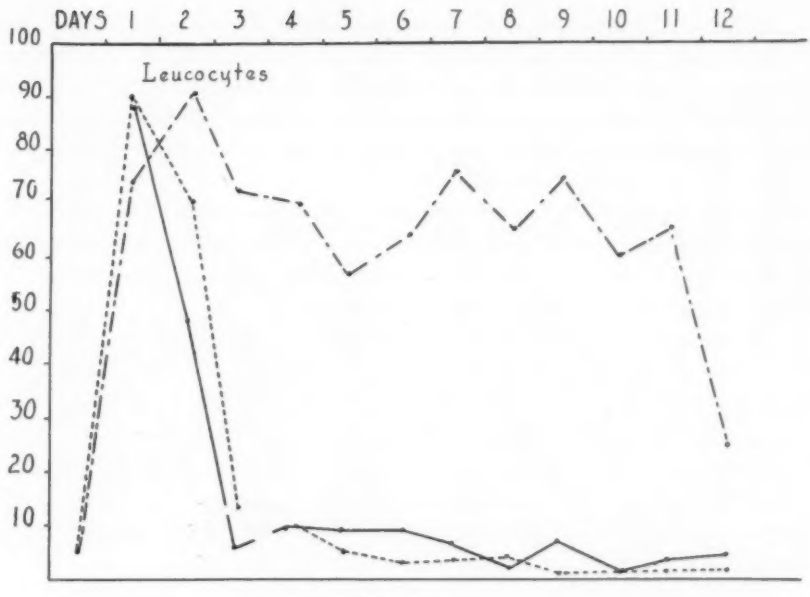


CHART 1

Daily percentage of leucocytes in the exudates of joints after:
A single injection of blood —— Seven injections of blood - - -
India ink — - — - .

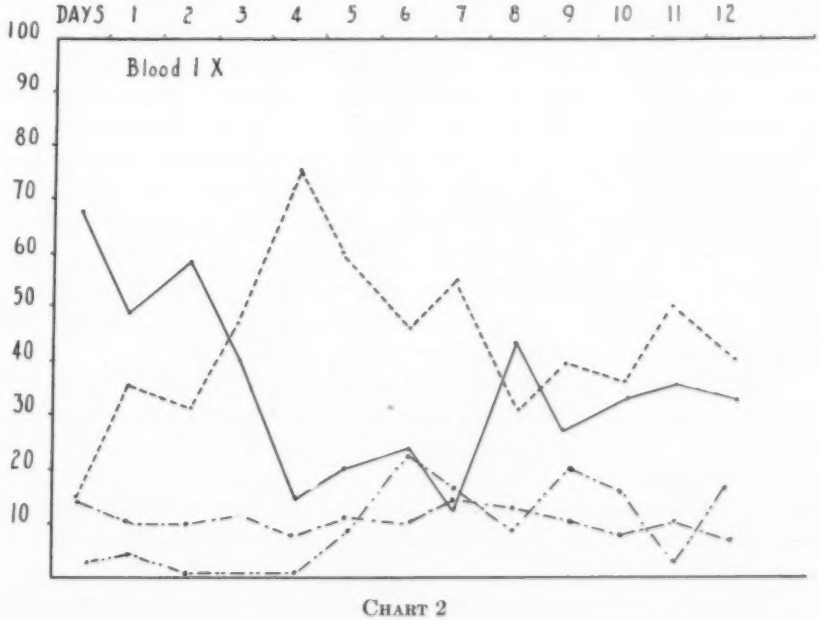


CHART 2

Relative percentages of the cells of the macrophage series in twelve joints after single injection of citrated blood:
Monocytes —— Indeterminate macrophages — - — - —
Clasmatocytes - - - - - - - - Primitive cells — - — - — - —

In the supravital preparations it was found that the leucocytes were practically all living actively motile cells. They were of the neutrophilic type (fine eosinophilic granulation in rabbits) and, in addition to the specific granulations, usually contained from one to three small neutral red granules. Non-motile and degenerating leucocytes were relatively rare, not over five per cent. being noted at any time.

As the leucocytes greatly outnumber all of the other cells on the first two days and are relatively unimportant after this time, they have been considered separately, and Charts 2, 3, and 4 are based on differential vital counts of only the cells of the macrophage series.

As the synovial membrane cells at no time comprised over seven per cent. of the nucleated cells of the exudate, it is obvious from Chart 1 that, except for the temporary leucocytosis after the injection, the joint fluids were populated largely by macrophages and primitive cells. These are all constituents of the normal joint fluid but were present in greater numbers and, as is evident from Chart 2, in abnormal proportions. The macrophages are classified as monocytes and clasmatocytes, using the criteria established by Sabin, Doan, and Cunningham[2].

The monocytes were present in about the normal proportion on the first three days, but after this time they were usually outnumbered by the clasmatocytes. For the most part they resembled the stimulated monocytes of normal joints and were rather large cells with well defined rosettes or central masses of neutral red and a moderate amount of neutral red granules and a few clear vacuoles in the peripheral portions of the cells (Plate 1, Fig. 1). On the first two days, however, the monocytes were predominantly of the young type with a large nucleus and a small rosette. These cells were evidently new arrivals in the joint and whether they were introduced with the blood or migrated into the joint it is impossible to say. However, they did not resemble the monocytes of the blood and conformed to the description of the young monocytes as given in the preceding paper[1]; so it is probable that they had migrated into the joint from the surrounding tissues. This opinion is strengthened by the appearance of a shower of very young monocytes in the joint examined eight days after the injection of the blood. In this joint fluid forty-two per cent. of the cells were monocytes and nearly all of these were of the young type.

The monocytes were rarely seen to exhibit progression or even movement of the granules within the cell. In this they resembled those of the normal joint. At no time were they seen to contain phagocytized red blood cells or even leucocytes. A few monocytes with two nuclei were seen in some of the preparations, but their number was always less than one per cent. of the monocytes present, and at no time was actual division of a monocyte seen to occur.

The clasmatocytes were the dominant type of macrophage in the exudates of this series. Whereas they normally comprise only about fifteen per cent. of the cells present, on the day after the injection they comprised thirty-five per cent., and on the fourth day seventy-five per cent. of the

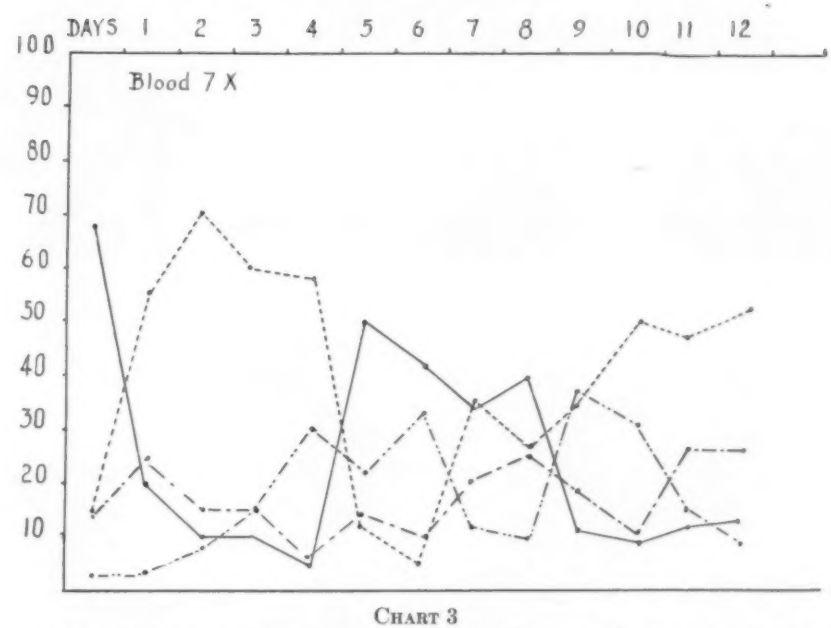


CHART 3

Relative percentages of the cells of the macrophage series in twelve joints after seven injections of blood.

Monocytes ——
Clasmatocytes - - - - - - - -
Indeterminate macrophages — - —
Primitive cells — - - —

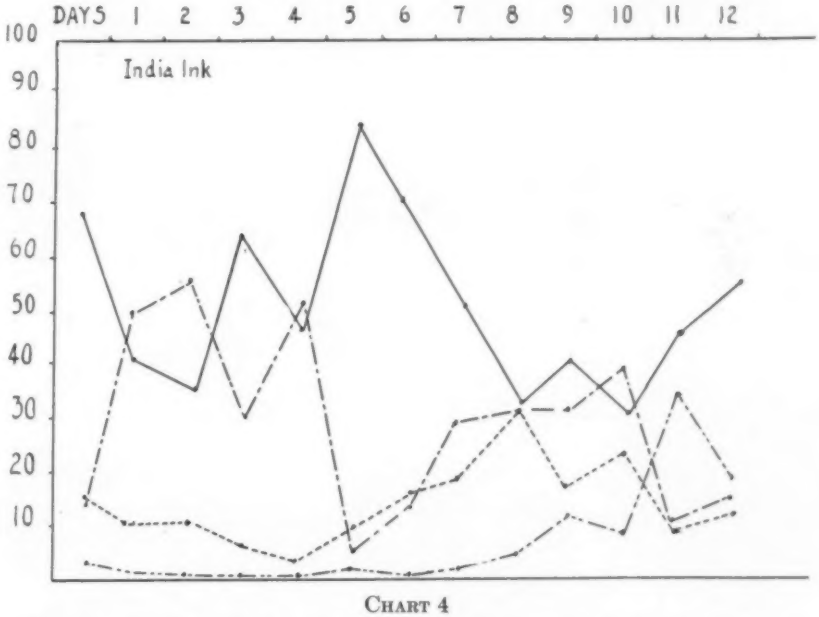
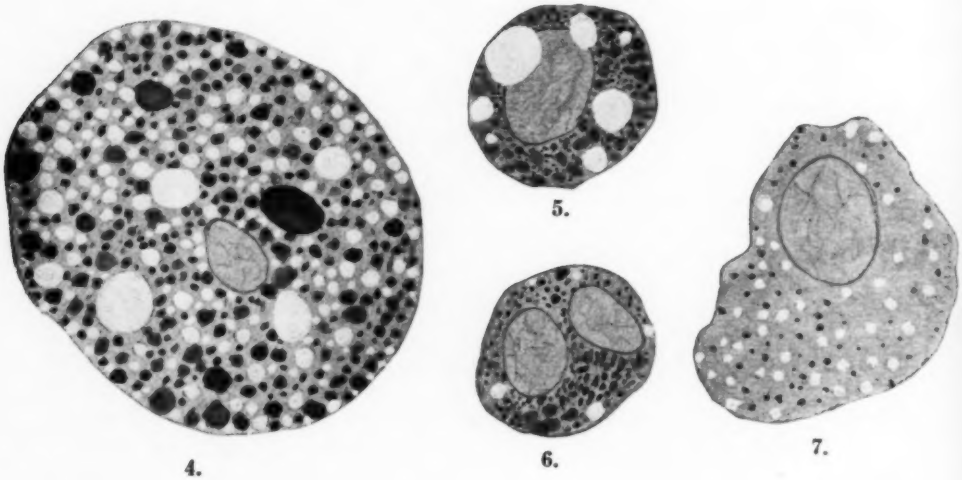


CHART 4

Relative percentages of the cells of the macrophage series in twelve joints after an injection of India ink:

Monocytes ——
Clasmatocytes - - - -
Indeterminate macrophages — - —
Primitive cells — - - —

1. 2. 3.



4. 5. 6. 7.

8. 9. 10. 11. 12.

13. 14. 15. 16.

PLATE 1

PLATE 1

Explanation of Figures

Plate 1. All cells were drawn with camera lucida, ocular 6 ×, objective 1/12 inch. The cells were stained supravitally with neutral red and Janus green. In all figures the neutral red is shown in various shades of grey and the clear vacuoles are white. In Figures 1, 2, 5, 6, and 7 the small black granules represent mitochondria. In Figures 8 to 16 inclusive the black granules represent carbon particles.

Fig. 1. Moderately stimulated monocyte similar to those found in normal synovial fluid.

Fig. 2. Moderately stimulated clasmatocyte similar to those found in normal synovial fluid.

Fig. 3. Clasmatocyte containing five phagocytized cells in various stages of degeneration. From an exudate after a single injection of blood.

Fig. 4. Large stimulated clasmatocyte from an exudate after seven injections of blood.

Fig. 5. Indeterminate macrophage from an exudate after seven injections of blood.

Fig. 6. Monocyte containing two nuclei from an exudate after seven injections of blood.

Fig. 7. Hypertrophied synovial lining cell from a joint which had received seven injections of blood. The mitochondria and clear vacuoles are increased in number.

Fig. 8. Young monocyte which contains a single carbon particle.

Fig. 9. Small monocyte containing several carbon particles most of which are near the periphery of the cell.

Fig. 10. Rather small monocyte in which the carbon particles appear to be mingled with the granules of the rosette.

Fig. 11. Motile monocyte in which the rosette is not visible.

Fig. 12. Clasmatocyte which contains a phagocytized cell (probably a monocyte) which in turn contains several carbon particles.

Fig. 13. Stimulated clasmatocyte which contains several large carbon particles and four degenerating leucocytes.

Fig. 14. Primitive cell which contains several small carbon particles.

Fig. 15. Small indeterminate macrophage which contains several carbon particles.

Fig. 16. Synovial lining cell from a joint which had received an injection of India ink. The cell contains five small carbon particles.

macrophage cells in the exudate were classed as clasmatocytes. They were not so numerous on the succeeding days but continued to be present in abnormally large numbers throughout the twelve-day period.

On the first day after the injection the clasmatocytes generally resembled the moderately stimulated type as described above in normal joints (Plate 1, Fig. 2). A few young clasmatocytes were present on the first day and a great many were present on the second and third days. Even the young clasmatocytes were moderately stimulated and contained irregular neutral red granules and clear vacuoles. Throughout the twelve-day period the joints contained a few quite large, highly stimulated clasmatocytes (Plate 1, Fig. 3).

In spite of the known affinity of the clasmatocyte for the red blood cell, as was pointed out by Sabin, Doan, and Cunningham[2], the clasmatocytes in these joints were rarely seen to contain a phagocytized red cell. A few such were seen on the second and third days. They did, however, phagocytize the dead leucocytes more readily. On the day after the injection a few clasmatocytes were seen which contained leucocytes. Some of these had been so recently phagocytized that not even the nucleus of the leucocyte was stained with the neutral red. As is known, in a phagocytized cell there is at first no staining, then the nucleus stains deep red, and later on there is a diffuse staining of the cytoplasm. On the third day, four per cent. of the clasmatocytes contained one or more leucocytes. After this time only an occasional such cell was seen. An occasional clasmatocyte contained two nuclei. It is interesting to note that these were usually the small (presumably young) clasmatocytes. No division of the clasmatocytes was seen to occur in any of the fluids of this series.

The indeterminate macrophages have been described in the preceding paper on normal joint fluids and need no description here. They are those macrophages which, when vitally stained, are not sufficiently characteristic of either type to admit of definite classification as either monocytes or clasmatocytes. They comprised about ten to fifteen per cent. of the cells of the macrophage series in the exudates.

The primitive cells did not begin to appear in abnormal numbers until the fifth day, when they comprised eight per cent. of the cells of the macrophage series. On the sixth day there was a shower of primitive cells, and in this joint twenty-two per cent. of the cells of the macrophage series were of the primitive type. After this time an abnormally large number of primitive cells was present in all of the joints of the series. The primitive cells resembled those described in the normal joint. All transitions between the primitives and the young monocytes were present in the exudates. In regard to the four per cent. of primitives noted in the twenty-four-hour exudate, it is probable that some of these were lymphocytes introduced in the blood which had not yet left the joint.

The synovial lining cells exhibited little or no tendency to become free in the joint fluid. They were most abundant in the ten-day experiment when seven lining cells were encountered in counting one hundred cells of the

macrophage series. The average for the twelve experiments was less than three per cent. lining cells. They resembled those found in the fluid of normal joints except that they were slightly larger. They exhibited no phagocytosis or tendency to stain with neutral red.

CHANGES IN THE JOINT FOLLOWING A SINGLE INJECTION OF BLOOD

Other than the presence of the exudate, the only macroscopic change noted in these joints was that the synovial membranes of the earlier joints of the series were slightly more pink than normal. The scrapings showed more leucocytes and macrophages than are found in the scrapings from a normal joint and the synovial membrane cells were more easily detached by scraping than are those of the normal joint. Stained supravitally these cells, during the first six or seven days after the injection, were somewhat larger than normal and contained more mitochondria and more clear vacuoles than did those from the normal joints. In the joints examined after the seventh day the scrapings disclosed nothing abnormal.

The sections of the fixed tissue were of more interest and will be dealt with in detail. On the day after the injection, the most striking feature was the marked infiltration of the tissues with leucocytes and the engorgement of the blood vessels near the joint surface. The leucocytes were, for the most part, extravascular and lay on the synovial surface, in the layer of cells in the surface, and in the loose tissue beneath these cells. The hyaline and fibrocartilage and dense fibrous tissue of the intra-articular ligaments and tendons were not infiltrated with leucocytes. At the borders of both the hyaline and the fibrocartilage, where the transition between the synovial tissue and the cartilage occurs, several leucocytes were seen quite far out in the zone where many of the cells were of the cartilage type.

The leucocytes were most numerous in the prepatellar fat pad and in the folds of the synovial membrane, especially in the posterior capsule. They were only moderately numerous on the sides of the femur where there is only a small amount of loose subsynovial tissue and the membrane is quite closely bound to the periosteum. In the lateral wall of the knee joint and in the region where the synovial membrane is reflected from the femur, the loose subsynovial tissue contained large numbers of leucocytes. In the quadriceps pouch where the muscle fibers approached the synovial surface, the muscle was infiltrated with leucocytes. In many sections the leucocytes were seen in clusters around small blood vessels and in all stages of progress through the walls of the vessels.

On the second and third days the number of leucocytes in the tissues had decreased greatly, and on the fourth day they had practically disappeared. A few leucocytes were present in the subsynovial tissues and especially in the regions of the quadriceps pouch, posterior capsule, and fat pad, up to the eleventh day after the injections. However, in the later joints these occasional leucocytes in the tissues were seen in only a few sections.

The synovial membrane cells may be divided into two fairly well defined groups: the cells in the dense surface tissue, and the cells which were supported by loose subsynovial tissue[3]. The cells in the dense surface tissue showed no change at any time after the injections. The cells supported by loose surface tissue showed definite changes on the day after the injection. These changes reached their maximum on the fourth or fifth day and the cells had returned to an approximately normal condition by the eleventh or twelfth day. The changse involved both the nucleus and the cell body. The nucleus became larger, more spherical in outline, and more reticular in structure. The cell bodies became larger and in some cases developed processes resembling those of fibroblasts. With the increase in size, many of the cells emerged more upon the synovial surface and in many instances tended to project into the joint cavity with their long axes perpendicular to the surface. In some instances, these cells contained one or more clear spherical vacuoles which resembled the chromophobe secretion vacuoles of the thyroid[4]. These enlarged cells showed a definite increase in mitochondria. The above changes were most marked in the posterior capsule, the fat pads, the fringes lateral to the quadriceps tendon, and the folds in the upper part of the quadriceps pouch.

Not only did the synovial lining cells become larger and more youthful in appearance, but they proliferated to a moderate degree. Mitotic figures were seen up to the fifth day. The proliferation of the synovial membrane cells was most marked in the areas mentioned in the preceding paragraph, where there was a loose subsynovial layer and an abundant blood supply. In the posterior capsule the cells were in some areas ten or twelve layers in thickness. There was definite increase in the folds or villi in the posterior capsule and fat pad and in the upper part of the quadriceps pouch, and the apices of these villi were unusually cellular (Fig. 1).

In the subsynovial tissue, the fixed connective tissue cells were enlarged and in many instances resembled fibroblasts. The infiltration of the tissues by leucocytes was accompanied and followed by an infiltration with macrophages. These macrophages were evidently wandering back and forth through the synovial membrane and accounted for part of the thickening noted above. In many instances in the sections, it was not possible to differentiate between the macrophages and the synovial membrane or connective-tissue cells. In some cases, the rosette of the monocytes was represented by a clear area in the hof of the nucleus. Other large irregular cells which contained one or more red blood cells were evidently clasmatocytes. Such cells were seen on the surface of the membrane, in the membrane lying between the surface cells, and in the subsynovial tissue. This infiltration with macrophages was most marked in the loose subsynovial tissues mentioned above, but was present in all parts of the joint except the cartilage and dense avascular areas. It was most marked on the fourth and fifth days. After this time, the number of macrophages in the subsynovial tissues gradually decreased. In the last joint of this series, exam-

ined twelve days after the injection of blood, they were slightly more numerous than normal.

The clasmatocytes, containing the red blood cells or fragments of red cells and pigment, tended to arrange themselves in layers between the loose subsynovial tissue and the denser tissue of the capsule surrounding it. In the region of the posterior capsule, they were arranged in nodules in the fatty tissue.

Several small collections of small and medium-sized round cells were noted in these joints. They lay just beneath the synovial layer and were seen in the prepatellar fat pad, the lateral margin of the quadriceps pouch, and in the posterior capsule. Mitotic figures were seen in some of these nodules. The cells were larger on the edges of the nodules and these were believed to be monocytes. The smaller cells in the center were probably primitive cells. The cells diagnosed as monocytes appeared to be wandering from the nodules into the joint.

The small blood vessels lying beneath the synovial surface were dilated and engorged with blood during the first four days following the injection. After this time they gradually returned to normal and were practically normal by the sixth or seventh day. Many dilated tissue spaces, probably minute lymphatic channels, were noted in the synovial membrane on the

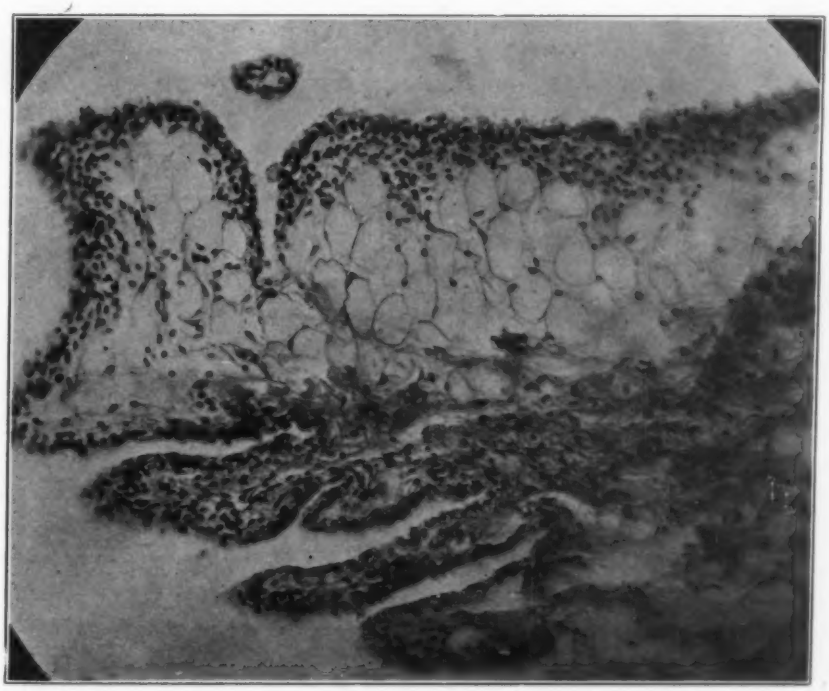


FIG. 1

Surface of fat pad five days after an injection of blood. The surface zone is hyperplastic and infiltrated with macrophages. The villi are hypertrophied and more numerous than normal. 8 mm. objective.

first three days after the injection. These were most numerous near the borders of the cartilage, especially in the fringes around the fibrocartilage of the quadriceps tendon.

Since the red blood cells had nearly all left the joint by the fourth day, several joints were studied from one to three days after the injection in an effort to determine just how and where the blood cells were removed from the joint cavity. Some of the blood escaped down the sheath of the tibialis anticus muscle and infiltrated the tissues of the leg. The clasmatocytes which wandered into the joint cavity phagocytized some red blood cells and carried them out into the subsynovial tissues to be slowly digested. In certain instances a few free red blood cells were seen in the synovial membrane, lying between the hypertrophied membrane cells or free in the subsynovial tissues. These were chiefly in the fat pad, the posterior capsule, and in the bottoms of the lateral pouches. In some instances small collections of extravasated blood were seen in the fat pad and posterior capsule. It is questionable whether or not these were due to trauma. A fourth method of the removal of blood was by the incorporation of small clots by the synovial membrane cells. The clot adhered to the synovial surface and was invaded by macrophages and fibroblasts. The red blood cells were removed by the macrophages and the synovial surface cells tended to invade the coagulated fibrin and to cover its free surface by growing over it from the margins. In one of these adherent fibrin clots, two giant cells were seen. There are then at least four ways by which the red blood cells can leave the joint: (1) through the sheath of the tibialis anticus muscle; (2) by being carried out by the macrophages (clasmatocytes); (3) by passing between the cells of the synovial membrane; and (4) by being incorporated in the synovial membrane in instances where the blood cells are held in fibrin clots. Of course, a certain amount of blood escaped by leaking back through the puncture made by the needle, but in most instances only a small quantity escaped by this route. No stomata were demonstrated in the synovial surface and no unusual numbers of red cells were seen in the popliteal or inguinal lymph nodes which drain the knee joint. It is probable that the greater part of the blood cells escaped by passing between the synovial cells and back into the tissues. There was no evidence that the fixed cells of the synovial membrane phagocytized the erythrocytes. The passing of the red cells between the synovial cells was seen to occur only in areas where large synovial cells were supported by loose areolar-like or fatty subsynovial tissue.

SYNOVIAL EXUDATES FOLLOWING SEVEN INJECTIONS OF BLOOD

In the second experiment, each knee joint received seven injections of citrated rabbit's blood over a period of twenty-four days. In this experiment only six rabbits were used. The last injections were given on alternate days and the animals were sacrificed every other day over a twelve-day period. Following the repeated injections, the joint cavities became somewhat enlarged, and at the later injections two cubic centimeters of

blood were given. The joints were then studied as in the preceding experiment, one joint being examined each day for a period of twelve days after the last injection.

On the day after the last injection the joint was distended with dark red glairy fluid. This was decreased in amount in the forty-eight-hour joint, and on the third day after the last injection the joint contained only a moderate excess of blood-tinged fluid. Some excess fluid, however, persisted in these joints throughout the twelve-day period, and up to the eighth day it was definitely blood-tinged. After this time the fluid appeared clear on macroscopic examination.

Microscopically, the exudate on the first and second days after the injection was intensely cellular and contained great numbers of red blood cells, leucocytes, and cells of the macrophage series. After this time the total number of cells decreased gradually, but even at the end of twelve days there was a definite excess of red cells and macrophages in the fluid.

The leucocyte content of the exudate for the twelve-day period is given in Chart 1. It is seen that on the day after the injection eighty-eight per cent. of the nucleated cells in the exudate were leucocytes. On the second day they comprised forty-eight per cent., and on the third day eleven per cent. After this time their proportion remained within normal limits (less than ten per cent. of the nucleated cells). The behavior of the leucocytes in the joints which had received seven injections of blood is strikingly like that of the leucocytes in the joints which had received only one injection of blood. For the most part they were actively motile and resembled those of the blood of the normal rabbit. At no time were they seen to contain phagocytized material.

The cells of the macrophage series comprised practically all of the nucleated cells in the exudates except the leucocytes, and after the second day dominated the picture. The relative proportions of monocytes, clasmatocytes, indeterminate macrophages, and primitive cells is given in Chart 3.

On the first day after the last injection of blood into the joint, the monocytes comprised only twenty per cent. of the cells of the macrophage series. The proportion was further decreased, until on the fourth day only four per cent. of these cells were monocytes. During this period the monocytes resembled those of the normal joint and were in a state of moderate stimulation. They were rather large cells of this type and contained a large number of neutral red granules and vacuoles in addition to the characteristic rosette of fine neutral red granules. An occasional large monocyte contained one or more dead leucocytes.

On the fifth day after the injection there was a sharp rise in the number of monocytes and they comprised fifty per cent. of the cells of the macrophage series. At this time the majority of these cells were of the mature stimulated type, though a few young monocytes were present. After the fifth day the monocytes continued to outnumber the clasmatocytes, until the tenth day when they dropped sharply and comprised only eleven per cent. of the cells of the series, and the number continued low until the end

of the period. At no time were the monocytes seen to contain phagocytized red blood cells. For the most part they were non-motile and rarely exhibited movement of the granules. They occasionally contained two nuclei but no actual division of a monocyte was seen to occur (Plate 1, Fig. 6).

It is to be noted that the abrupt increase in the monocytes encountered in the five-day and six-day exudates of this series was not typical and did not occur in a control experiment. In this animal, treated as were the ones of this series, the cells of the macrophage series in the five-day exudates were: monocytes twenty-eight, clasmatocytes fifty-one, indeterminate macrophages fifteen, and primitives six per cent.; and the six-day exudate contained: monocytes thirty, clasmatocytes thirty-nine, indeterminate macrophages twelve, and primitives nineteen per cent.

As in the joints subjected to a single injection of blood, the exudates in the series after seven injections contained an unusually high percentage of clasmatocytes. On the first four days after the injection they comprised more than half of the cells of the macrophage series (Chart 3). During this period the clasmatocytes were for the most part small or medium-sized, but a few very large ones were also present (Plate 1, Fig. 4). Practically all of the clasmatocytes were in a state of stimulation and contained granules and vacuoles, some of which stained with neutral red while others remained clear unless the cells were over-stained.

In addition to the usual content of phagocytized matter, some of the clasmatocytes in all of the exudates examined during the first five days after the last injection contained leucocytes or red blood cells or both. This phagocytosis was most marked on the second day after the last injection. At this time twenty per cent. of the clasmatocytes contained one or more leucocytes and eight per cent. contained one or more erythrocytes. The phagocytosis was most marked in the large cells, but was not limited to them as many small clasmatocytes had engulfed a leucocyte which almost filled the cell body. Some of the larger cells contained as many as six leucocytes and four erythrocytes.

After the fifth day, cells containing leucocytes or erythrocytes were not seen in any of the exudates. The clasmatocytes in the later exudates, however, averaged larger in size and contained more neutral red and clear vacuoles than did those of the earlier exudates. This was due to the presence of many young clasmatocytes in the earlier exudates. In the later joints the cells more nearly resembled those present in the normal joint fluid.

Clasmatocytes containing two nuclei were occasionally seen, especially in the earlier exudates, and upon one occasion a clasmatocyte was seen in the process of division and was observed until the division was complete and the two daughter cells had rounded up as typical clasmatocytes. As the division of clasmatocytes apparently occurs very rarely in supravital preparations and has not been noted by other observers, the process will be described in detail.

When first noted, the clasmatocyte in question was a large dumb-bell-shaped cell which contained two small nuclei, and three leucocytes and two

red blood cells. Each large end of the cell body contained a nucleus and in one there were two leucocytes and a red blood cell, while the remaining leucocyte and red blood cell were in the other end. The thick band of protoplasm connecting the two was about half the diameter of the cell bodies and contained several small clear vacuoles and a few neutral red granules.

The pointer in the eye piece was placed near one end of the cell and the slide was not moved until the division had been completed. One half of the cell remained stationary near the pointer, while the other half moved slowly away from it. As the cells became separated, the band of protoplasm uniting them became gradually thinner and the granules and vacuoles in it moved to the cell body nearest them. Finally, the strand of clear protoplasm, very thin in its middle part, broke and the tapering ends were slowly retracted to the respective cell bodies. Both daughter cells then rounded up as typical clasmatocytes. The process consumed about twenty minutes. It was interesting that one daughter cell remained stationary throughout the process, while the other one moved slowly away from it. The process of movement was peculiar in that the cell simply seemed to float slowly away and at no time was any motion of the cell or even of the granules within the cell perceptible to the eye. After the division was complete, the daughter cell which had moved, progressed over to the edge of the oil-immersion field and then settled down and had not changed its position a half hour later.

The above is evidence that the clasmatocytes do possess the power of movement, though the movement is very slow and may be likened to that of the hands of a clock in that it cannot be detected, except by noting change of position from time to time. The same is true of the change in shape of clasmatocytes while under observation. The writer has often watched them change shape without actually seeing movement of the granules or of the cell body. This type of movement is definitely different from that of the monocytes which is similar to, though much slower than that of the leucocytes and is accompanied by definite streaming of the intracellular granules.

The indeterminate macrophages were more numerous than in the exudate following the single injection of blood. In this series, they averaged about twenty per cent. of the cells of the macrophage series. This was due to the fact that the repeated injections acted as a stimulus to the cells of this group and many of them contained so much phagocytized material that their typical structure was obscured, and it was not possible definitely to identify them as either clasmatocytes or monocytes (Plate 1, Fig. 5).

The primitive cells were very numerous in these exudates and on four occasions they comprised thirty per cent. or more of the cells of the macrophage series. They were similar to the primitive cells described in normal joints, and exhibited no motility or phagocytosis, though some of them contained a few small neutral red granules. For the most part they were small and resembled small lymphocytes. Transition stages between the primitive cells and the young monocytes were frequently seen, but there

was no constant relation between the number of primitive cells and the number of monocytes present in the exudates.

Synovial lining cells were very rarely met with in the exudates of this series, and in seven of the twelve joints none were seen. Those present did not stain with neutral red and exhibited no powers of phagocytosis. They resembled the similar cells of the normal joint fluids except that they were somewhat larger in size (Plate 1, Fig. 7).

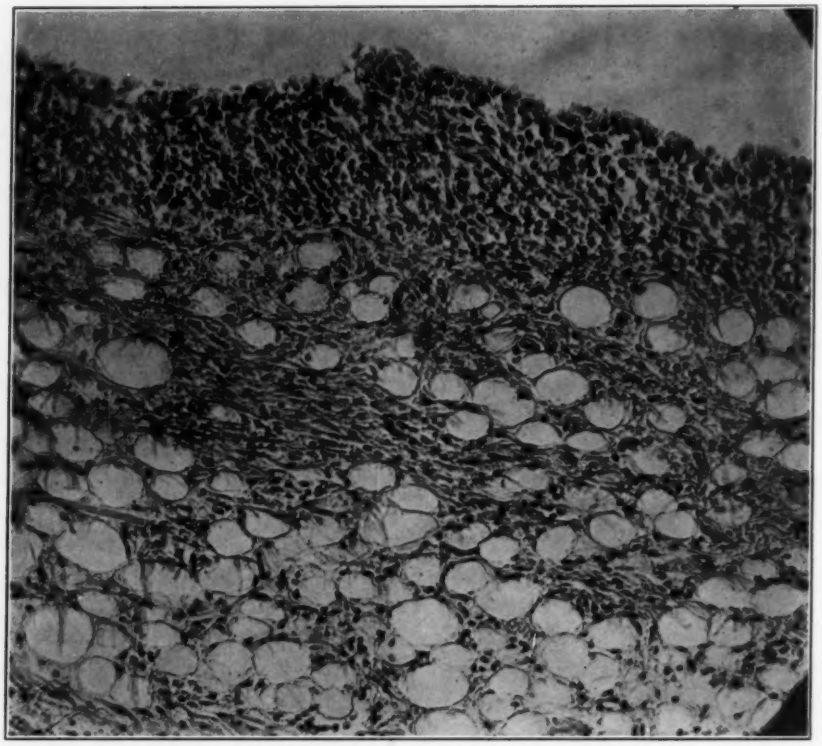


FIG. 2

Surface of the fat pad twenty-four hours after the seventh injection of blood. Hypertrophy and hyperplasia of the cells of the synovial membrane and subsynovial tissue and infiltration with leucocytes, macrophages, and red blood cells. 8 mm. objective.

CHANGES IN THE JOINT FOLLOWING SEVEN INJECTIONS OF BLOOD

The synovial cavities of all of these joints were moderately enlarged from the repeated injections. In all of them the fat pad was hypertrophied and the synovial membrane was slightly thickened and velvet-like in appearance. Areas of light brown pigmentation were seen in most of these joints and in some there were a few minute hemorrhagic areas. Most of them contained small clots of blood and fibrin which were adherent to the

synovial membrane in the quadriceps pouch or in the lateral spaces where the synovial surface is reflected from the sides of the femur to the lateral capsule. The cartilage and dense fibrous tissue in the joint surface were normal to macroscopic examination.

Microscopic examination of the joint, studied twenty-four hours after the last injection, revealed considerable thickening of the synovial membrane in all of those areas where it is supported by loose vascular subsynovial tissue. Not only was the membrane thicker and more cellular than normal, but it and the tissues beneath were infiltrated with leucocytes and macrophages. In most areas the synovial membrane cells were definitely larger than normal and their nuclei were moderately swollen and stained less deeply than normal. They varied in shape from spherical or ovoid cells to tall columnar cells. In most areas, two or three layers of these cells were loosely arranged upon the subsynovial tissue and the taller ones often projected into the joint cavity. Many of the synovial cells contained rather large clear vacuoles which, in many instances, gave the impression that they were secretions of the cells which were being discharged into the joint cavity (Fig. 2).

In the subsynovial tissue the connective-tissue cells were more numerous than normal and youthful in character, with large vesicular nuclei and large faintly basophilic cell bodies. They resembled the typical fibroblasts of young connective tissue and could be differentiated from the macrophages by their long processes, and by the fact that many of the macrophages contained red blood cells or masses of pigment from broken down red cells.

The thickened hyperplastic subsynovial tissue was more vascular than normal and contained many young capillaries. In many areas these were engorged with blood. This was especially true in the fat pad where the proliferation of the connective-tissue cells extended far into the fat tissue. In addition to the increase in the cells and blood vessels, there was also a definite increase in the collagenic fibers in the subsynovial tissue. Connective-tissue stains showed large numbers of very fine collagenic fibers just beneath the synovial membrane cells. Mitotic figures were seen in the synovial membrane cells and in the fibroblasts.

In the twenty-four-hour joint, leucocytes were very numerous just beneath the synovial membrane cells, between these cells, and on the synovial surface. In the deeper subsynovial tissue the infiltrating cells were largely macrophages, and many large cells, apparently clasmatocytes, which were engorged with red blood cell particles and pigment, were arranged in rows along the inner surface of the fibrous capsule of the joint. Near the surface a moderate number of red blood cells were free in the subsynovial tissue and in the spaces between the loosely arranged synovial membrane cells.

The extensive hypertrophy and infiltration described above were present over the fat pad and in those regions of the joint where the synovial membrane was supported by loose vascular tissue. In regions where the

FIG. 3

A moderately fibrous area on the side of the femur four days after the seventh injection of blood. The synovial cells are enlarged and the subsynovial tissues are moderately infiltrated with small round cells. There is much less reaction than occurred in the loose areas of the joint. 8 mm. objective.

membrane rested on rather dense fibrous tissue which contained relatively few blood vessels, the synovial cells were swollen and more numerous than normal, but there was usually only a single layer of these cells on the surface, and the infiltration of the subsynovial tissues was much less in degree than occurred in the loose vascular type of subsynovial tissue. This represented a type of reaction intermediate between the extensive reaction of the loose vascular areas and the practical absence of any reaction which was characteristic of the dense fibrous areas (Fig. 3).

Many folds and villi were present on the fat pads, and in the quadriceps pouch these were larger and more cellular than normal. In the lateral recesses of the joint cavity where the synovial membrane is reflected from the side of the femur, large clots of blood and fibrin were adherent to the surface. In these areas the synovial surface was ill defined, as the cells resembled fibroblasts and were invading the adherent coagulum (Fig. 4).

Along the borders of the hyaline and fibrocartilage, the synovial membrane was in many places hypertrophied to form fringes or villi which tended to project over the adjacent border of the cartilage. The surface of the cartilage was, as a rule, normal, but in some areas it was roughened and

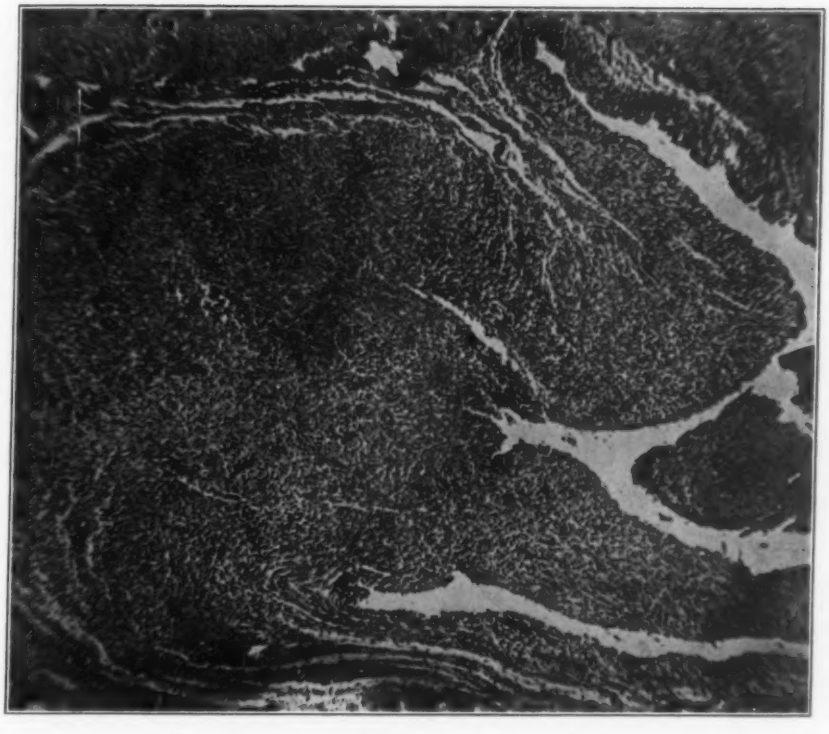


FIG. 4

Bottom of lateral pouch two days after the seventh injection of blood. Marked hyperplasia and thickening of the subsynovial tissues with formation of large villi. The tissue is infiltrated with red blood cells, leucocytes, and macrophages. 16 mm. objective.

frayed. The cartilage cells were not enlarged and showed no proliferation except near the borders where the reaction in the synovial membrane tended to involve the adjacent cartilage for a short distance. Here there was some infiltration of the cartilage with leucocytes and macrophages and some of the peripheral cartilage cells were enlarged and resembled fibroblasts.

In the joint examined two days after the last injection, the infiltration of the tissues with leucocytes was present in about the same degree as in the one-day joint described above. The only noticeable difference between the two joints was that the infiltration of the synovial membrane and subsynovial tissues with red blood cells was more marked in the two-day joint (Fig. 5) and a larger percentage of the synovial cells contained clear vacuoles.

In the joint examined on the third day after the last injection, the leucocytes had almost entirely disappeared from the subsynovial tissue, and very few were present in any of the later joints. As the leucocytes disappeared, the infiltration with macrophages increased. Mitotic figures

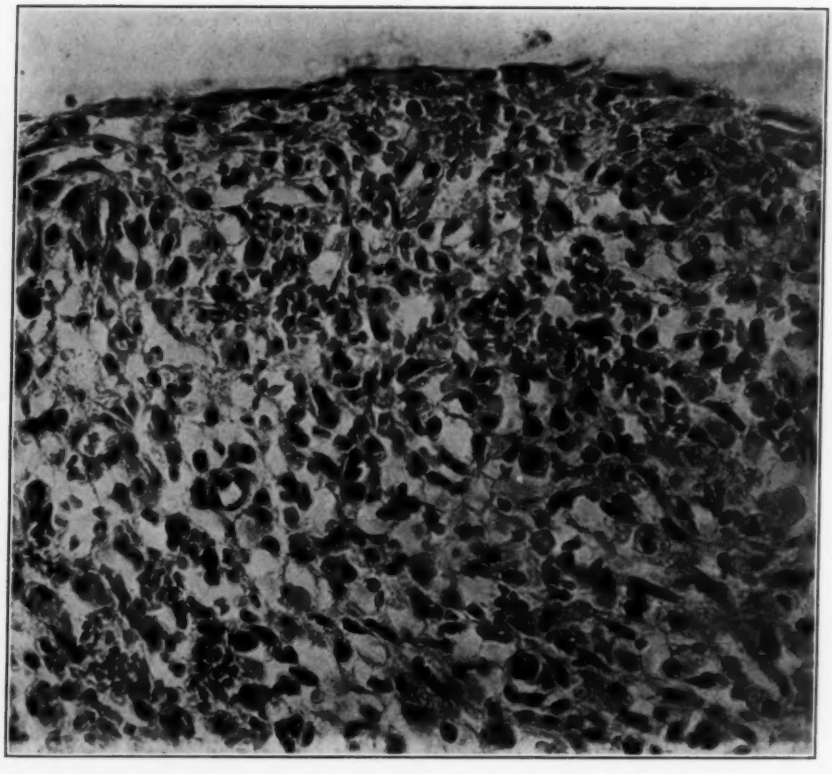


FIG. 5

Side of femur of the same joint. The hyperplastic tissue is infiltrated with red blood cells and the synovial surface is not well formed. 4 mm. objective.

were seen and the changes noted in the twenty-four-hour joint continued to progress for five days after the last injection. The hypertrophy of the fat pad and villi and the thickening and infiltration of the synovial membrane were most marked in the four-day and five-day joints of this series. The infiltration of the tissues with red cells decreased after the third day, and very few extravascular erythrocytes were seen in the tissues of the joints examined more than five days after the last injection. Exceptions to the above were the areas where coagulated blood or fibrin was adherent to the surface and was being invaded by macrophages, fibroblasts, and young blood vessels. In these areas the red cells persisted until they were phagocytized by the macrophages (Fig. 6).

The collections or nodules of small round cells such as were described in the joints which received a single injection of blood, were seen in the subsynovial tissues of many of these joints which had received seven injections of blood, and here the nodules were larger and more frequently contained mitotic figures. The cells in the center were usually small with dark nuclei, while the peripheral cells were larger and resembled the smaller

macrophages in the surrounding tissues. These nodules are believed to be foci for the production of young macrophages and the smaller central cells are believed to be primitive cells. Many of them might be described as perivascular nodes of round cells, while others apparently had no definite relation to the blood vessels.

A large pedunculated villus is illustrated in Figure 6. This was located in the lateral pouch and attached to the loose tissue where the capsule was reflected from the side of the femur. It had evidently been formed by an attempt on the part of the synovial membrane to incorporate and organize a large clot which was adherent to the surface in this area. The side of the villus next to the femur was composed of fibrin and contained a few fibroblasts. In the central area there were large numbers of erythrocytes and macrophages with a moderate number of fibroblasts and young blood vessels. The apex and the lateral border were formed of young connective tissue which was infiltrated with macrophages and contained a few nodules of small round cells. Several of the fibroblasts contained mitotic figures. The surface of the fibrin was not covered by cells, but other parts of the villus were covered by synovial membrane continuous with that of the adjacent joint surface. The synovial cells appeared to be fibroblasts

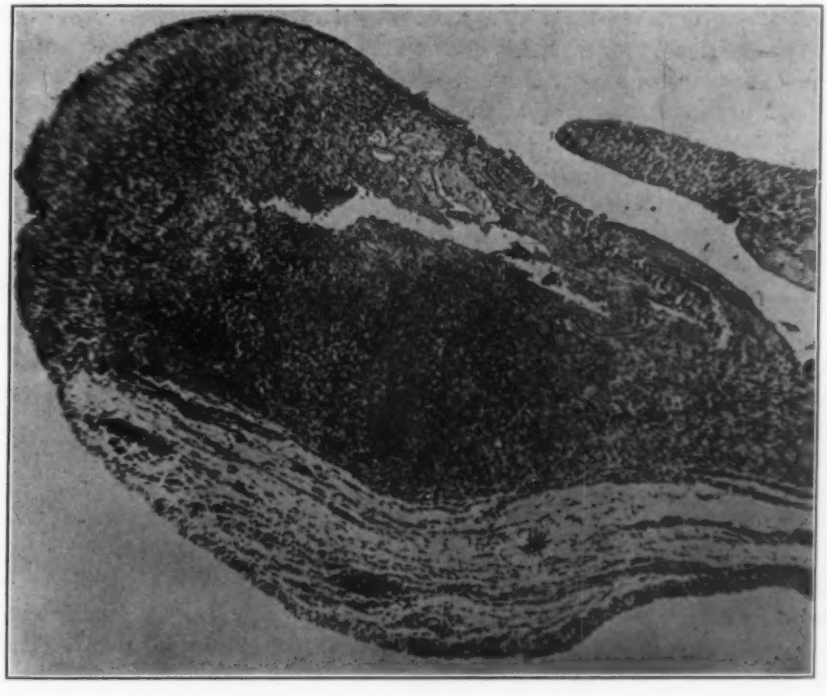


FIG. 6

Large villus projecting from the bottom of the lateral pouch six days after the seventh injection of blood. The central and inferior portions are a mass of coagulated blood and fibrin which is being invaded and organized by the young connective tissue forming the base and superior portions of the villus. 16 mm. objective.

which were oriented upon the surface and differed from the fibroblasts beneath the surface in that they did not possess the long slender processes.

The above described villus illustrates fairly well the method by which the clots which adhered to the surface in many of these joints were incorporated and organized by the synovial membrane. The process was really an invasion from beneath and from the sides rather than a growing over of the surface cells to cover the clot. In Figure 6 it is seen that although a large portion of the clot was being organized, a considerable area remained uncovered by cells. The new surface of these areas is largely formed by fibroblasts which migrate to the surface and become synovial cells. Many of these fibroblasts apparently arose from the original synovial cells which, when covered by the clot, reverted to the young type of connective-tissue cell and wandered out into the clot. The term "synovial cell" is used in all of these descriptions, but it is simply a connective-tissue cell which, because of its location on or near the free joint surface, is slightly specialized.

In the later joints of the series there was a gradual reversion to a condition resembling that of the normal joint, though the normal condition was not reached at the end of twelve days after the last injection. In the eleven-day and twelve-day joints, the folds and villi of the synovial membrane were considerably larger and more numerous than normal, but were much less prominent than in the four-day and five-day joints; also, the synovial cells were smaller and their nuclei were more pyknotic than were those of the earlier joints. In most areas they formed a well-defined surface layer of one or two rows of cells which were about half again as large as those of corresponding areas in the normal joint.

The subsynovial tissues were definitely thicker and more cellular than normal. In some areas the connective-tissue cells were of the large fibroblast type, but as a rule, they were small fibroblasts with rather pyknotic nuclei and closely resembled those of the normal joint. There was moderate infiltration of the subsynovial tissues with macrophages and a few nodules of small round cells were seen in both the eleven-day and the twelve-day joints. The macrophages in these joints were, as a rule, rather small, but many large ones loaded with red-blood-cell pigment were seen in some of the sections. These were usually rather deep in the subsynovial tissues.

The collagenic fibers in the subsynovial tissues were definitely more abundant in these later joints than in corresponding areas of normal joints. This was best seen in the fat pad where, in a wide zone beneath the surface, few fat cells were present and the tissue consisted of rather young connective-tissue cells scattered through a network of delicate collagenic fibers. In the loose subsynovial tissue of the quadriceps pouch and lateral capsules, the increase in the fine collagenic fibers was definitely present, but the fibrosis was not so noticeable here as it was in the fat pad. Whether or not this slight fibrosis of the subsynovial tissues is permanent has not yet been determined. In the later joints of this series the blood vessels in the subsynovial tissues were considerably larger and more numerous than they are in the normal joints.

SYNOVIAL EXUDATE FOLLOWING THE INJECTION OF INDIA INK

On the first two days after the injection of one and five-tenths cubic centimeters of the diluted India ink, the knee joint was distended with a black fluid. This decreased in amount and became lighter in color from day to day. The joint examined six days after the injection contained only a moderate excess of light brown fluid. A slight excess of fluid persisted in these joints throughout the twelve-day period.

The black exudate present on the first two days after the injection contained a large number of free carbon particles. These diminished rapidly and in the exudate of the six-day experiment only a few minute particles were free in the fluid. At this time, nearly all of the carbon remaining in the joint had been taken up by the cells of the exudate. After the sixth day, there was very little change in the amount of free carbon in the fluid, and some fine granules were free in the exudate of the twelve-day joint. It is probable that the free carbon in the later exudates had been previously phagocytized and then returned to the fluid either by ejection from the leucocytes, or by degeneration of macrophages.

The exudates of the joints examined during the first five days after the injection of the ink were highly cellular. After this time the cell content gradually diminished but remained greatly above that of normal synovial fluid throughout the twelve days. In the vitally stained preparations, the cells could be identified as leucocytes, synovial membrane cells, and cells of the macrophage series (monocytes, clasmatocytes, indeterminate macrophages, and primitive cells).

As in the other experiments, the leucocytes were present in great numbers on the first two days after the injection, and on the second day they comprised ninety per cent. of the nucleated cells of the exudate. In this series, however, the leucocytes did not rapidly disappear from the joint on the third or fourth day after the injection, but their number remained high until the twelfth day when there was a sudden drop from sixty-four per cent. in the eleven-day exudate to twenty-five per cent. leucocytes in the twelve-day exudate (Chart 1). This sudden decrease in the percentage of leucocytes in this joint was unusual and was not present in a second control experiment. In this joint examined twelve days after the injection of the India ink, sixty-one per cent. of the nucleated cells in the exudate were leucocytes.

The leucocytes of the exudates were similar to the neutrophils of the normal rabbit's blood and for the most part were actively motile. On the third day, twelve per cent. of the leucocytes were non-motile or degenerating, but after this time the number of such cells was much smaller. Phagocytosis of carbon particles by the leucocytes was observed throughout the experiment, but was most active during the first six days. On the first three days, ten to twelve per cent. of the leucocytes contained one or more carbon particles, and on the next three days, fifteen to twenty per cent. of the leucocytes contained carbon. After this time, only five to six per cent.

of the leucocytes contained carbon. As a rule the leucocytes each contained only from one to three small carbon granules, but in some instances, six or eight medium-sized carbon granules were present in a single leucocyte. The mass of the phagocytized material in such an instance was about equal to that of the normal leucocyte, but even this heavy load did not stop the streaming of the granules or the motility of the cell. In some of the leucocytes in neutral red preparations, one or more of the ink granules was surrounded by a faint red halo, thus suggesting that the one or two small red vacuoles of the leucocytes are analogous to the segregation vacuoles of the macrophages. Some of the non-motile and degenerating leucocytes contained carbon. But as the number of such cells was always small, there was nothing to suggest that the phagocytosis of carbon either hastened or retarded the death of the leucocytes.

Not only did the leucocytes in the joint take up carbon, but upon more than one occasion a leucocyte was seen to rid itself of a carbon particle. The method was as follows: The carbon particle was manoeuvered to the border of the cell; then the leucocyte streamed rapidly away, leaving the carbon in a tongue of protoplasm which it dragged along for some distance until the carbon was cast off, either by a rupture of the cell wall or a breaking off of the tongue of protoplasm containing it. Often the protoplasmic process containing the carbon retracted to the cell body and the manoeuver was repeated until finally the cell was rid of the carbon.

The cells of the macrophage series took up large amounts of the India ink and on the first four days after the injection, over ninety-five per cent. of the macrophages in the exudate contained carbon particles. During this period the cells, as a rule, contained such large amounts of carbon that in a great many of them the typical structure of the cell was obscured and it was necessary to class them as indeterminate macrophages. After the fourth day, the number of macrophages which contained ink gradually decreased until on the twelfth day only forty per cent. of the cells of this series contained carbon. The average amount of carbon in each cell was much less in the later experiments. The cells of this series also actively phagocytized the dead leucocytes and in some instances took up leucocytes which contained ink (Plate 1, Fig. 12). The phagocytosis of leucocytes was most extensive during the fifth to the eighth days after the injection, when from seven to ten per cent. of the macrophages contained one or more leucocytes, and occasionally one contained a red blood cell

In Chart 4 it is seen that in the joint exudates following the injection of India ink, the monocytes are the dominant cell of the macrophage group. At no time did they comprise less than thirty per cent. of the macrophages, and during the first seven days after the injection they averaged more than fifty per cent. of this group. When one considers the large number of indeterminate macrophages present in these joints, it is obvious that the actual number of monocytes present is really much higher than is indicated by the counts, because it is probable that the greater part of these indeterminate macrophages were monocytes in which the characteristic struc-

ture was obscured by the large amount of ingested carbon. It is interesting that in these joints most of the cells which could be definitely identified as monocytes were of the comparatively young type. This was particularly true on the fifth day when eighty-four per cent. of the macrophages were classed as monocytes. On this day a shower of young monocytes was present in the joint and apparently had not yet had the time to take up sufficient carbon to obscure their structure.

Even the young monocytes actively phagocytized the carbon particles and some times these small cells could be identified as monocytes after they had taken up quite large amounts of carbon. The carbon was usually stored in the manner characteristic of monocytes for other phagocytized material. That is, it did not, as a rule, invade the rosette unless a large amount was present in the cell and the general tendency was for the carbon to be held in the peripheral portions of the cell (Plate 1, Fig. 8). In many instances, however, some carbon granules lay between the rosette and the nucleus (Plate 1, Fig. 9). In other cases the carbon occupied the region of the rosette. Such a cell is shown in Plate 1 (Fig. 10). In this cell the hof of the nucleus was filled by a mass of large neutral red vacuoles many of which could be seen to contain ink particles. In the spaces between these red vacuoles were many small ink granules. It is to be noted that when a macrophage which contains carbon is stained with neutral red, the tendency for the red to surround and partly obscure the carbon is not so great as is the case with cells containing trypan blue. Occasionally one sees carbon granules in red vacuoles, but for the most part the carbon appears to be free in the cytoplasm.

As a rule, the monocytes in these exudates resembled those of normal joints in that they were rounded up and non-motile. However, some of the larger stimulated cells exhibited the slow streaming motion of the granules and the slow motility characteristic of monocytes. One such cell is illustrated in Plate 1 (Fig. 11). These cells, though well stained, contained no visible rosette. They are classed as monocytes because of the characteristic motility. Many monocytes which contained two nuclei were observed, but no actual division of a monocyte was seen to occur. The mitochondria of the younger monocytes were typical, but staining with Janus green was not satisfactory in cells containing fine carbon granules, as it was difficult to differentiate the dark green from the black. Consequently, mitochondria were not identified in the cells containing a large amount of carbon. In these they were certainly decreased and in many of them there were probably no mitochondria present.

The clasmatocytes in most of the exudates comprised less than fifteen per cent. of the macrophages. On the eighth day, however, many young clasmatocytes were present and they comprised thirty per cent. of the cells of the macrophage series. They phagocytized the carbon particles quite as avidly as did the monocytes and in addition many of them contained one or more leucocytes. In this series, very few monocytes were seen which contained leucocytes. The clasmatocytes varied from rather small

to very large cells, but for the most part were rather larger than those found in the normal joint (Plate 1, Figs. 12 and 13). They stored the phagocytized material in the characteristic manner: either close to the nucleus or scattered irregularly through the cytoplasm. In some of them many of the ink particles were inclosed in vacuoles which stained with neutral red. This tendency for the ink granules to be surrounded by a red vacuole was much more marked in the clasmatocytes than in the monocytes. The clasmatocytes exhibited no motion, were all mononuclear, and no division was seen to occur in this series.

In Chart 4, it is seen that an unusually large number of indeterminate macrophages was present during the first four days after the injection, and again from the seventh to the tenth day. This was due to the fact that these macrophages phagocytized so much carbon that the cell structure was obscured. Some of these cells were obviously degenerating and did not take up any neutral red. Such cells usually contained a refractile nucleus and the cell body was completely filled with carbon particles. Most of these indeterminate macrophages, however, stained with the neutral red in the manner characteristic of living cells. The red granules or vacuoles, as a rule, did not surround the ink granules. Many of the indeterminate cells in the later exudates resembled those of the normal joint and did not contain enough ink to obscure the structure of the cell (Plate 1, Fig. 15). In other instances the cell structure was obscured by the phagocytized leucocytes. As in the other experiments, there were all transitions between the indeterminate macrophages and the clasmatocytes and monocytes.

Very few primitive cells were seen until the ninth day when twelve per cent. of the macrophages were of the primitive type. A shower of primitives was present in the eleven-day exudate, and in this joint fluid thirty-six per cent. of the cells of the macrophage series were primitives. It was rather surprising to find a few minute carbon granules in the cytoplasm of many of these primitive cells (Plate 1, Fig. 14).

Detached synovial membrane cells were rarely seen in the exudates following the injection of the ink. Those seen were usually larger than those of the normal joint and contained a few small carbon particles and clear vacuoles (Plate 1, Fig. 16). Apparently these cells were not capable of taking up the large carbon particles. In no instances were they seen to contain large amounts of ink. These cells, even when containing carbon, were not stained by the neutral red.

CHANGES IN THE JOINT FOLLOWING THE INJECTION OF CARBON PARTICLES

In this report only the changes noted during the first twelve days after the injection will be described. The ultimate fate of the India ink and the later changes in joints into which it had been injected have been dealt with in a previous paper[4].

In the joint examined on the day after the injection, the fat pad and synovial membrane in the quadriceps pouch were greyish brown in color. In the two-day joint these areas were black and the rest of the synovial membrane, where it rests upon loose subsynovial tissue, was grey to black. In the later joints the entire joint surface except those areas composed of cartilage or dense fibrous tissue was dark grey to deep black and there was definite thickening of the synovial membrane and hypertrophy of the fat pad. In these early joints the cartilage and dense fibrous tissue areas of the joint surfaces were not stained and presented no gross abnormalities.

Microscopically, the twenty-four-hour joint showed slight changes in the synovial membrane and in the tissues immediately beneath it. In areas where the subsynovial tissue was loose and vascular the synovial cells were slightly larger than normal and their nuclei were larger and more vesicular than are those of similar cells in the normal joint. The tissues were moderately infiltrated with leucocytes and macrophages, but there was no evidence of cell proliferation either in the synovial membrane or in the subsynovial tissues. The infiltration was more intense around the smaller blood vessels. Many of these were dilated and contained large numbers of

FIG. 7

Surface of the fat pad two days after the injection of India ink. The ink is sticking to the surface and a small amount has penetrated into the tissues near the surface. Many of the leucocytes and macrophages which infiltrate the tissue contain carbon particles. The blood vessels are dilated. 4 mm. objective.

leucocytes, many of which were sticking to or in various stages of migration through the vessel walls. In some areas the subsynovial tissues were oedematous and contained relatively few cells of any kind. The cartilage and fibrous areas of the joint surface showed no abnormalities other than the presence of a small amount of India ink on the surface.

The amount of India ink which remained on the synovial surface varied from a very thin brown surface line to a dense black layer of ink and fibrin which in some places was from twenty to twenty-five microns in thickness. As a rule, the surface line was sharply defined and no ink had passed into the tissues, but in some areas a few minute black granules, or a pale brown pigmentation beneath the surface zone, indicated a slight penetration of the tissues by the free ink particles. This penetration of the surface was most often seen in the less fibrous areas of the surface where the synovial cells were larger and more superficial. Many of these which were on the surface contained a few minute carbon granules. In the subsynovial tissues a moderate number of the leucocytes and macrophages contained a variable amount of carbon particles.

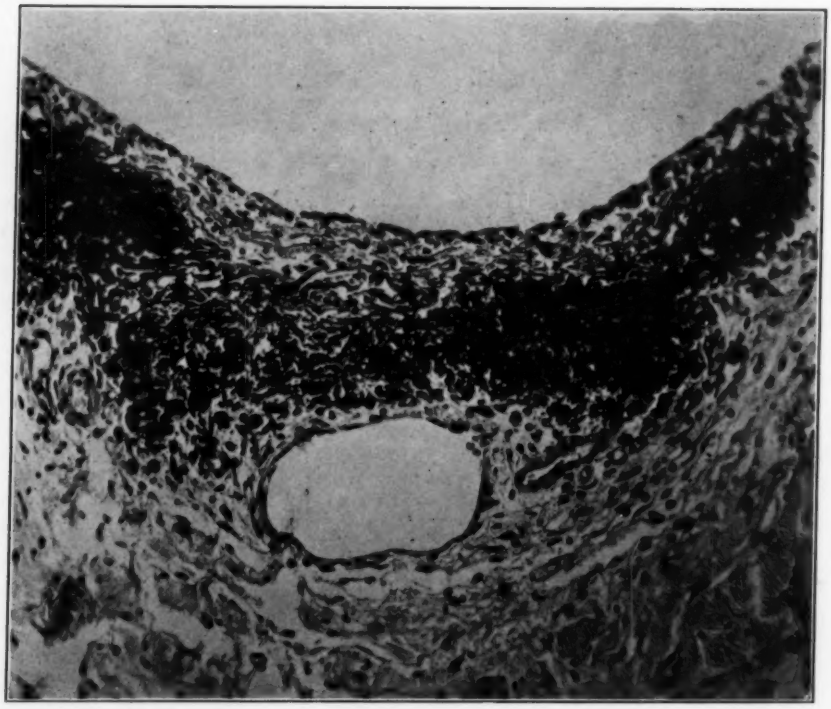


FIG. 8

Mass of India ink and fibrin adherent to the synovial membrane in the quadriceps pouch four days after the injection. On the right the synovial surface is intact for a short distance where the clot has been pulled away. In the rest of the field the surface line has disappeared and the cells are invading the clot. The surface of the clot is formed by a layer of macrophages all of which contain India ink. 16 mm. objective.

Two days after the injection of the India ink the synovial cells were markedly increased in size. They contained large clear vesicular nuclei but no mitotic figures were seen and there was little tendency for the synovial cells to emerge upon the surface and project into the joint cavity. The connective-tissue cells in the loose subsynovial tissues resembled fibroblasts and were more numerous than normal. In these areas there were large numbers of leucocytes and macrophages. Free carbon particles were more abundant in the subsynovial tissues, generally, and in the upper end of the quadriceps pouch where the muscle fibers lie very close to the joint surface, a considerable amount of the ink had infiltrated the muscle. In the two-day joint the synovial cells contained more carbon particles, and the leucocytes and macrophages which contained carbon were more abundant in the subsynovial tissues than they were in the twenty-four-hour joints (Fig. 7).

The changes mentioned above were slightly more advanced in the joint examined three days after the injection of the carbon, and this joint also contained several small masses of fibrin and carbon particles which were adherent to the synovial surface. Where this occurred, the line of the surface was in places poorly defined and the synovial cells could not be

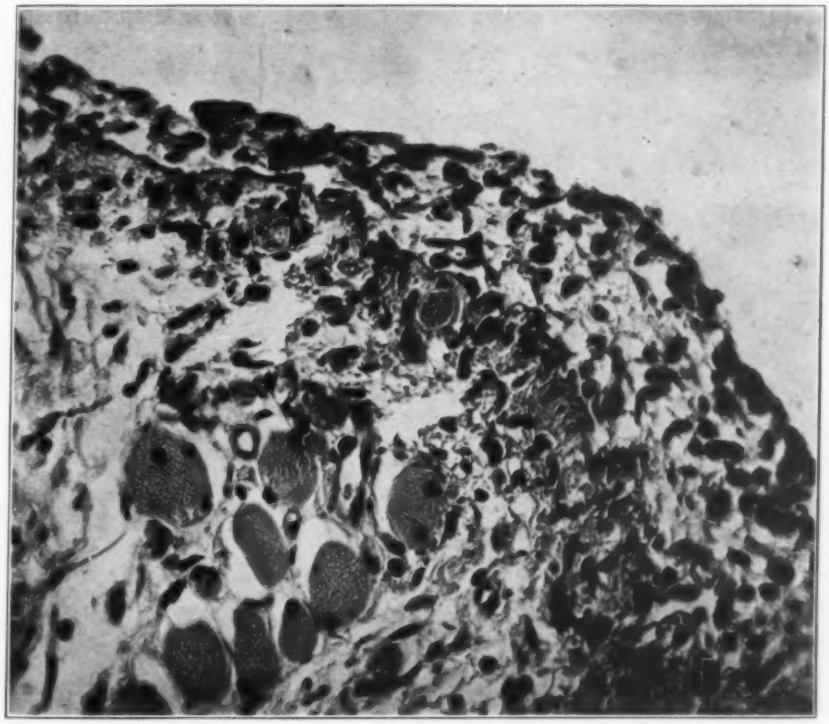


FIG. 9

Same clot but a field near the other end where the synovial surface can be followed beneath the adherent exudate and becomes indistinct on the right of the figure. 4 mm. objective.

differentiated from the fibroblasts. In such an area from a joint examined four days after the injection, the line of the surface could be followed for some distance beneath the edge of the clot and then it disappeared entirely, and there was no line of demarcation between the subsynovial tissue and the fibrin, but a gradual merging of one into the other while the fibroblasts were invading the adherent clot (Figs. 8 and 9). Most of the ink was contained in macrophages and the surface of the clot was covered with a single layer of macrophages which contained relatively little carbon.

In the five-day joint, the most striking feature was the proliferation of fibroblasts in the loose subsynovial tissue. In many parts of this joint the surface cells rested on a thick layer of young connective tissue, and in the fat pad the proliferation of fibroblasts extended throughout the fat tissue. There was no marked proliferation of cells which could be differentiated as synovial cells and the surface, as a rule, consisted of a single layer of large cells which closely resembled the fibroblasts. The subsynovial tissue consisted of a mass of fibroblasts and young blood vessels and contained very few collagenic fibers. It was moderately infiltrated with macrophages and leucocytes, and a few of the fibroblasts contained mitotic figures (Fig. 10).

At this time, five days after the injection, most of the free India ink had left the joint cavity and was to be found in the tissues. In the young

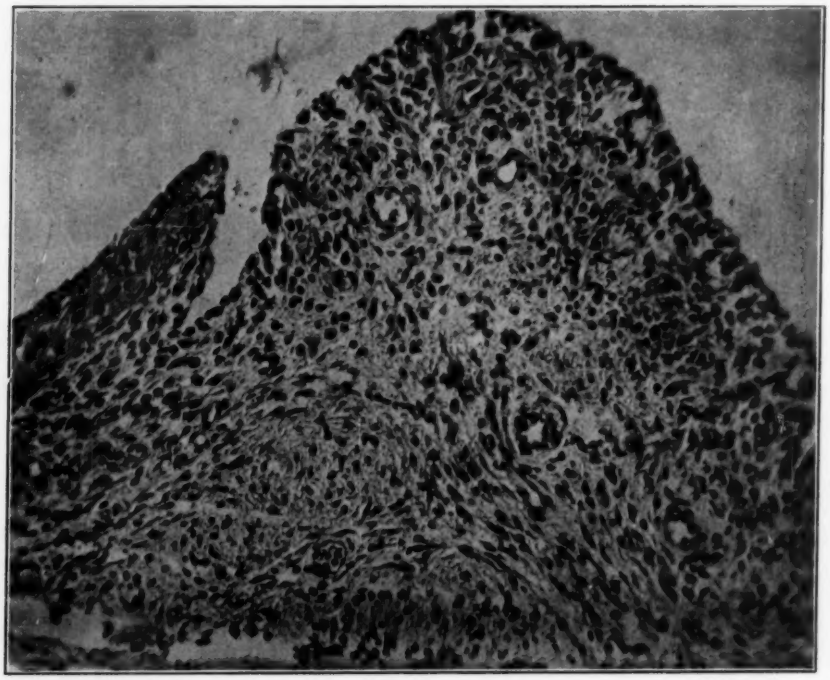


FIG. 10

Edge of the fibrous surface of the femur forming the floor of the quadriceps pouch in a joint five days after the injection of India ink. On the left of the hyperplastic tissue a small fibrin clot is adherent to the synovial surface. 8 mm. objective.

connective-tissue areas described above there was a moderate amount of ink scattered through the tissue near the joint surface. The greater part was, however, contained in the cells. Practically all of the surface cells contained a few (five to ten) small or medium-sized granules of carbon, and the same was true of many of the fibroblasts and macrophages which were near the surface. In the deeper subsynovial tissue only a few of the fibroblasts contained the black granules. The macrophages were for the most part loaded with the carbon granules and many of them appeared as masses of coarse black granules with a definite outline, but in which no nucleus or cell protoplasm could be detected.

Many of the macrophages which were loaded with carbon had wandered deep into the subsynovial tissues and lay along the inner surface of the fibrous capsule of the joint. In some places they formed a deep black layer, several cells in thickness between the fibrous capsule and the loose subsynovial tissue. Others remained in the loose tissue and tended to collect in circumscribed masses or nodules in which practically all of the cells were loaded with carbon. In the central areas of these black nodules many of the cells were degenerating and consequently a great deal of the carbon was no longer contained in the cells, but was scattered through the mass of engorged and degenerating macrophages.

The condition described above as being present in the five-day joint is fairly typical of what was found in the later joints of the series. The cell proliferation continued throughout the twelve-day period, and the thickening of the subsynovial tissues and hypertrophy of the fat pads were considerably greater in the later joints. In the seven-day joint the subsynovial layer of young connective tissue was about half again as thick as was that of the five-day joint, and in the twelve-day joint it was about twice as thick as was that of the seven-day joint. A few mitotic figures were seen in the surface and subsynovial cells of the twelve-day joint and the loose subsynovial tissue still consisted largely of fibroblasts and young blood vessels and gave every evidence of continued growth. It contained a few collagenic fibers but there was no definite fibrosis of the joints within the period of these observations.

The coagulated masses of fibrin and India ink, which in the earlier joints were adherent to the synovial membrane, were in the later joints incorporated in the membrane and invaded by fibroblasts and young blood vessels, as well as by macrophages and leucocytes. Most of the fibrin in such masses had disappeared in the eleven-day and twelve-day joints and the fibroblasts had reached the surface and formed a layer of synovial cells similar to that covering the rest of the joint.

In none of these joints was there a marked hyperplasia of the surface cells with a resultant formation of several layers of closely packed synovial cells. The surface cells were larger and more numerous than normal and in many areas lay with their long axes perpendicular to the surface and projected into the joint cavity, but they usually formed a surface layer only one cell in

thickness. In the later joints, practically all of them contained a moderate number of carbon particles.

The extensive cell proliferation was limited to the loose subsynovial tissues, and these continued to increase in thickness throughout the twelve-day period. They were infiltrated with leucocytes and macrophages throughout the time of observation, but in the later joints the proportion of leucocytes to macrophages was slowly and progressively decreased. In the seven-day joint and in all of the ones of longer duration, a variable number of nodules of small round cells were present in the loose subsynovial tissue. These resembled those described in the joints which had received the injections of blood and are believed to be collections of primitive cells which were proliferating and forming young macrophages (Fig. 11).

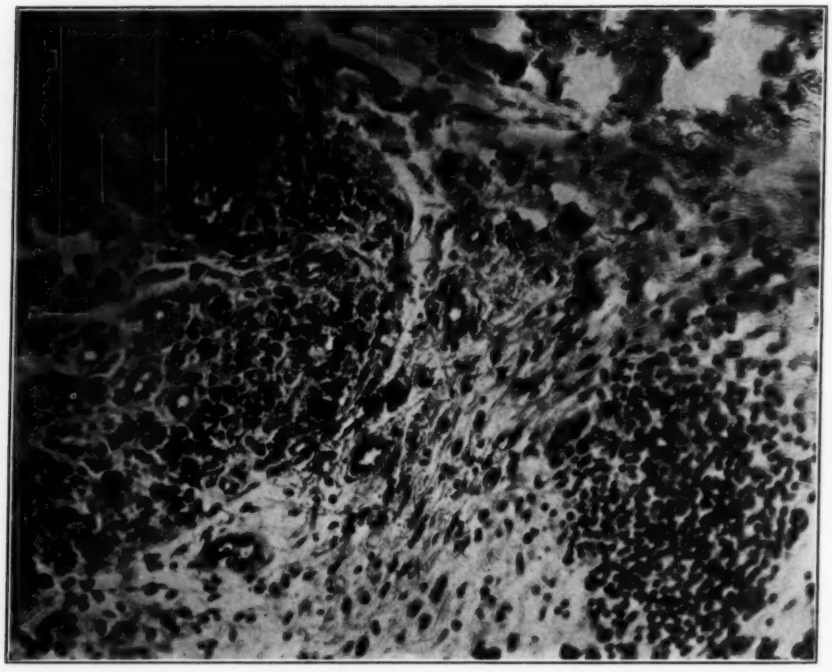


FIG. 11

Lateral capsule nine days after the injection of India ink. The synovial surface is on the left and there is a nodule of small round cells in the subsynovial tissue on the right. 8 mm. objective.

In the later joints the deep black nodules and layers of engorged and degenerating macrophages and free carbon particles were invaded by macrophages, fibroblasts, and young blood vessels, and there was very little free India ink in the tissues, except that localized in the compact masses of degenerating macrophages. In some of them there were a great many small round cells, and some of these primitive cells or very young macrophages contained a few minute carbon particles. Some of the more compact

masses were apparently being encapsulated by fibroblasts. The fibroblasts in the subsynovial tissues of the eleven-day and twelve-day joints resembled the surface cells in that nearly all of them contained a few small carbon particles.

There was very little change in the hyaline or fibrocartilage or dense fibrous surface areas in any of these joints. The hypertrophied fringe formed along the border of the cartilage in many of the joints, but the hyperplastic tissue exhibited little tendency to invade the cartilage or dense fibrous tissue. In some instances the free surface of one of these dense tissues was roughened and slightly frayed, and in such areas a few minute carbon granules might be found in the superficial areas or even in the cells, but, as a rule, the ink did not penetrate any of the dense surfaces of the joints.

SUMMARY AND CONCLUSIONS

An injection of citrated blood into a normal joint caused the production of a cellular exudate which gradually disappeared in about twelve days. During the first two days after the injection, the majority of the nucleated cells in the exudates were leucocytes; but after this time their number diminished rapidly and most of the cells in the exudates were macrophages and an unusually large percentage of these were clasmatocytes.

The exudates caused by seven injections of blood were similar to the above, but the macrophages were larger and more numerous.

In the exudates caused by India ink, both the leucocytes and the macrophages remained in the joint throughout the twelve-day period and the majority of the macrophages were monocytes. In none of the joints did the synovial-lining cells exhibit any tendency to be shed off into the joint cavity.

The primitive cells resembled lymphocytes and all transitions between these cells and monocytes were seen in exudates. As collections of small round cells were seen in the subsynovial tissues it is believed that the monocytes in the exudates were largely derived from these primitive cells which multiplied in the adjacent tissues. Since showers of primitive cells were present in some of the exudates which were due to injections of blood, it is regarded as probable that the clasmatocytes were also derived from these cells.

The red blood cells were phagocytized only by clasmatocytes and apparently most of them left the joint cavity by filtering through the loose areas of the synovial surface. A few were carried out by clasmatocytes and some were entangled in fibrin clots which became adherent to the synovial surface and were organized and covered by synovial-lining cells and thus excluded from the joint cavity.

The India ink was phagocytized by leucocytes and macrophages and most of it was carried out of the joint cavity by the macrophages. A small amount of the finely divided carbon filtered through the loose areas of the synovial surface and a small amount was taken up by the synovial lining

cells. Some of the ink was entangled in fibrin clots and these were excluded from the joint by organization just as were the blood clots.

A single injection of blood caused a mild proliferation of the synovial lining cells and infiltration of the subsynovial tissues with leucocytes and macrophages, but the tissues returned to normal in about six days.

After repeated injections of blood the synovial membrane was markedly thickened. The synovial lining cells were increased in size and number, but the thickening was largely due to the proliferation of the connective-tissue cells in the loose subsynovial tissues and to the infiltration of these areas with macrophages and leucocytes. The proliferation of the surface cells and subsynovial tissues varied inversely with the density of the tissue forming the synovial surface, and in the loose areas of the joint resulted in the formation of large villi.

On the third day after the last injection the leucocytes had largely disappeared from the joint tissues, but the macrophages remained throughout the duration of the experiment. In the eleven-day and twelve-day joints there was a gradual reversion of the tissues to a condition approaching the normal, but the hyperplasia persisted for a much longer time than the experiment lasted.

The injection of India ink into joints caused a proliferation of the surface cells and subsynovial tissues which continued to progress throughout the twelve-day period. The changes were limited to the loose areas of the joint surface, and the tissues were infiltrated with leucocytes and macrophages throughout the twelve-day period. The macrophages were engorged with carbon and tended to collect in nodules or layers next to the fibrous capsule, where they degenerated and left the carbon free in the tissues.

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A SIMPLE COMPLETE DIAGNOSTIC X-RAY UNIT ADAPTED TO ALL POSSIBLE SURGICAL AND MEDICAL NEEDS

BY HERMAN B. PHILIPS, M.D., NEW YORK

The ideas incorporated in this unit were conceived four years ago, while the writer was roentgenologist to the Hospital for Joint Diseases, New York City. It was designed originally for biplane fluoroscopy in the treatment of fractures and a new radiolucent fracture stretcher was submitted with the presentation of the biplane fluoroscope, for the first time, at the Orthopaedic Section of the New York Academy of Medicine, on February 20, 1925[1].

To attempt to fluoroscope or roentgenograph a broken bone, in more than one plane, with the patient on a Hawley, Albee, or Oppenheimer fracture table, is to invite the keenest disappointment. The construction of these fracture tables does not permit such procedures with any degree of success. The extreme weight, the bulkiness, and the radiopacity, as well as the dangers of high-tension shock, discourage even consistent attempts in this direction. The advantages of simultaneous biplane fluoroscopy in the treatment of fractures is apparent to those experienced in this type of work. To be able to manipulate fragments of a fractured bone, while the limb is in an extension and retention device, and to be able at any time within a few seconds, to fluoroscope or roentgenograph the bones in two planes, one at right angles to the other, approaches the ideal in the treatment of fractures.

Numerous attempts to check up fractures, fluoroscopically and radiographically, during the process of their reduction, and a discussion with Dr. Harry Waite of Long Island City, who devised the first compact, shock-proof x-ray unit, culminated in the first apparatus of this type, which was described in the Journal of the American Medical Association on June 13, 1925 (LXXXIV, 1824)[1]. To facilitate the fluoroscopy and radiography of the parts while being treated in a fracture apparatus, the new radiolucent fracture stretcher was devised and combined with this x-ray unit. Since that time, numerous changes have been made in the apparatus, so that at the present time it is adapted for all types of exacting, special as well as general, surgical and medical diagnostic x-ray work.

The writer is impelled at this time to call the attention of the profession to the existence of this versatile apparatus with so many advantages and of general utility, because of numerous inquiries about it and also because of a few recently published articles in Radiology[2], The American Journal of Roentgenology and Radium Therapy[3] and in *The Journal of Bone and Joint Surgery*[4], on new fracture stretchers and biplane fluoroscopes, which, in his estimation, are incomplete and lacking in fundamentals in their construction, thoroughly provided for in the apparatus which he designed originally.

The apparatus consists of two separate units, the fracture stretcher and the roentgen-ray unit, which will be described separately.

The fracture stretcher is, as its name implies, a stretcher with a tubular frame (Fig. 1). All the accessories are movable on the frame, and can be attached to any part of it. The extension and traction devices present no radical departure from the previous types except in one respect. They do not work from a central pivot, but are attached to any desired part of the frame or extensions from it. Traction upward is provided for by detachable accessory parts, which fit over the hip or axillary uprights.

The stretcher is made of aluminum, and is radiolucent in all parts within the frame. The supporting frame is of square tubing sections and when assembled with the aluminum cushions makes a complete fracture table, which can be placed on any x-ray or other table, or bed. It is fitted with standard Hawley fracture table accessories, and in addition, a special newly designed shoulder support for upper extremity work. The superstructures (metal cushions) are of aluminum, radiolucent, and attachable to any part of the frame. The central main cushion is hinged, so that it will collapse, as shown, facilitating access to hip or shoulder.

The stretcher can be so arranged that the perineal post becomes the axillary post and the patient's arm can be suspended above the fracture

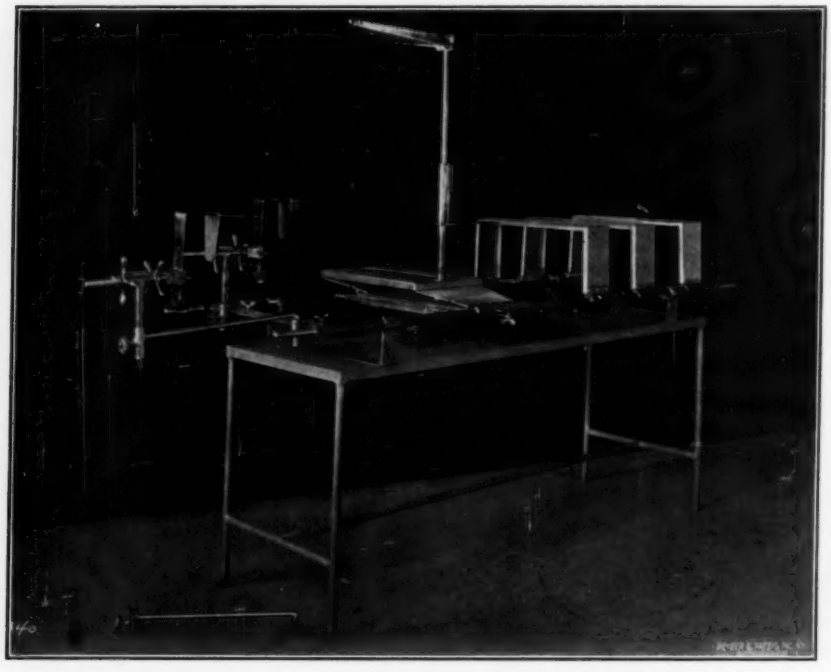

FIG. 1

Fracture stretcher adjusted for treatment of lower extremity fracture. Main cushion is collapsed leaving sacral support in position.

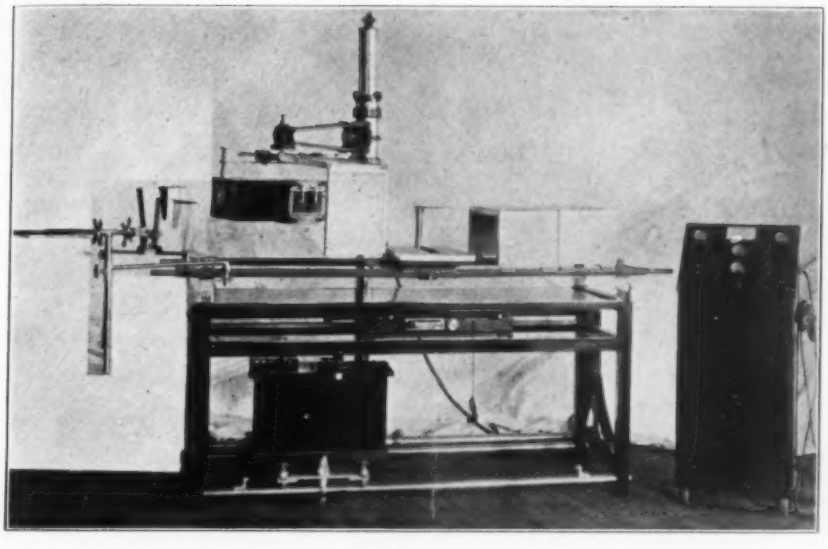

FIG. 2

Fracture stretcher on biplane fluoroscopic table. Roentgen-ray units and screen are adjusted for the treatment of a lower extremity fracture. X-ray unit of the latest design but without table tilt.

frame for manipulation during fluoroscopy. The foot or arm supports are provided with extensions to accommodate tall patients and adjustable for unusual positions and all possible requirements. The supports and extremity accessories of the frame are adjustable so as to accommodate the stretcher on any size or shape table and for any size individual, including children.

The construction of the stretcher is such that any part of the body may be suspended by the traction device without mechanical interference during manipulation or immobilization and at the same time provide ready accessibility for fluoroscopy or radiography with an absolute minimum obstruction to the fluoroscopic or radiographic fields by radiopaque parts of apparatus.

The stretcher is light in weight, and easily transported to roentgen-ray operating rooms or anywhere, even in ambulances, while the parts are securely immobilized in the adjustable mechanism. It can be used as a fracture table entirely independent of roentgen-ray machinery or in conjunction with roentgen-ray apparatus, as described. The entire stretcher, including the frame, is collapsible and occupies very little space when disassembled.

The new roentgen-ray unit presents several radical departures from present-day apparatus. It consists essentially of two separate, compact, shock-proof roentgen-ray plants incorporated with a tilt Potter-Bucky table. One unit is underneath the table on rails in such a way as to be

easily moved under any part of the table. The other unit is suspended from a single upright bar at the back of the table. It is constructed so as to enable the operator to place the unit at any place over or behind the table and to point it in any desired direction, facilitating examinations on beds or stretchers, without moving the patients onto the x-ray table. The Potter-Bucky diaphragm is on rails and can be easily moved. The upper roentgen-ray unit is suspended in such a way that any angle or position is obtainable with it, and when not in use it can be pushed back, entirely out of the way.

Each roentgen-ray unit consists of an oil-immersed transformer and tube capable of 60,000 volts with 30 milliamperes. The apparatus is absolutely shock-proof, as well as silent. The operator or patient can touch any part of the apparatus, as well as the roentgen-ray units, while in operation, without experiencing the slightest perceptible shock. The oil-immersed apparatus thus provides this tremendous advantage, particularly suited for this type of work. No high-tension dangers exist. The control cabinet is at the right of the table and permits, by simple controls, including a foot switch, the operation of either unit independently, or the two simultaneously.

Figure 2 shows the fracture stretcher in position on the roentgen-ray table. The central main cushion is collapsed, with the hip rest in position for the support of the patient. The traction devices are arranged for the treatment of a fracture of the lower extremity. Figure 3 shows a patient suspended on the fracture stretcher for treatment of a fractured femur. A double fluorescent screen, which folds over on itself like the covers of a book and can be swung out of the way when not in use, is attached to the upper transformer. The vertical screen is illuminated by the upper roentgen-ray unit, and the horizontal one by the roentgen-ray unit under the table. The Potter-Bucky diaphragm is displaced to the other end of the table, out of the way. In this way biplane fluoroscopy is agreeably feasible, almost instantaneously, at any stage of the reduction or immobilization of a fracture.

In adapting the apparatus for the treatment of a fracture of the upper extremity, what has previously been described as the hip rest is adjusted transversely and now supports the shoulder and adjoining parts of the back (Fig. 4). The hip upright now becomes the shoulder upright, the combination permitting manipulation and application of plaster without any interference. The upper roentgen-ray unit can be rotated in the direction of the vertical screen. The horizontal screen is illuminated by the transformer under the table, which has been rolled into position. In a few seconds, the screens as well as the upper roentgen-ray unit can be pushed out of the way. Thus, it is also possible to manipulate and immobilize fractures of the upper extremity under direct biplane fluoroscopic guidance. It should be mentioned that each screen has a tunnel attachment for a film cassette, so that, with very slight additional trouble, roentgenograms can be secured.

FIG. 3

Patient set for biplane fluoroscopy of fractured femur. X-ray table is one of the first models, but clearly shows biplane fluoroscopic feature.

FIG. 4

Patient set for biplane fluoroscopy of upper extremity fracture, on older model x-ray table.

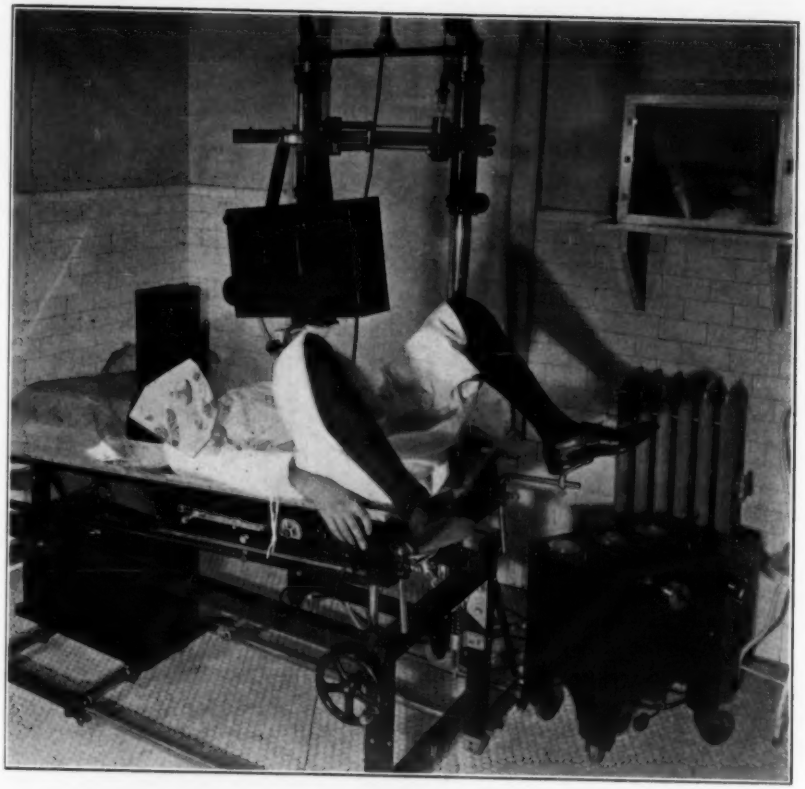

FIG. 5
Patient set for urologic examination. Old model table with tilt.

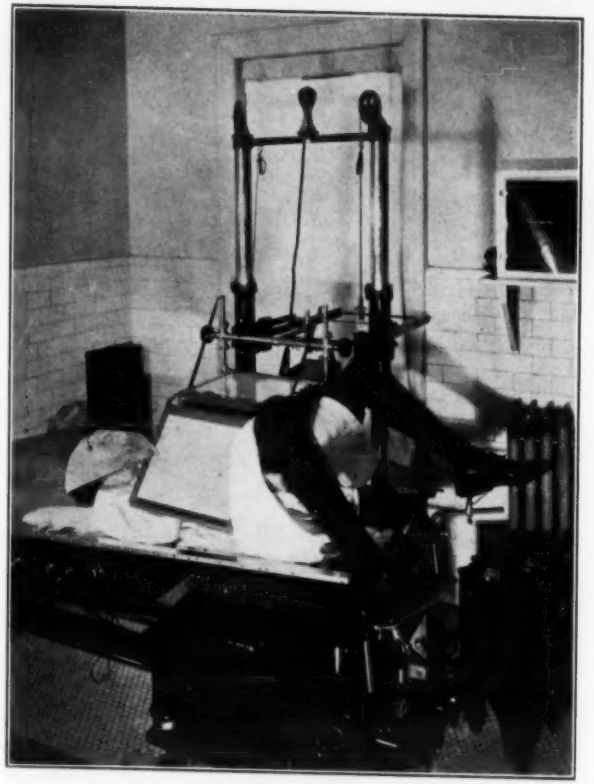

FIG. 6
Machine set for urologic fluoroscopy on old model table.

It is quite obvious that the apparatus presents advantages applicable to other surgical and diagnostic procedures. Biplane fluoroscopy is particularly desirable in the removal of foreign bodies in the lungs, as well as elsewhere.

The machine has also been especially adapted for urologic work. A crank is visible in the lower right corner of the table which enables the operator to elevate or depress one end. Figure 5 shows the unit adapted for urologic work. The table is tilted and the diaphragm is brought into position for roentgenographic work. Stirrups are provided at the end of the table. If desired at any stage of the examination, fluoroscopy can be resorted to by displacing the Potter-Bucky diaphragm and getting the lower roentgen-ray unit into position, with the horizontal screen (Fig. 6).

The table is adapted for upright fluoroscopy by removal of the horizontal screen, permitting the patient in the space between the upper tube unit and the vertical fluoroscopic screen (See Figure 8). Of course, with a complete ninety-degree tilt table, this feature is unnecessary and the horizontal fluoroscopic screen becomes available as a vertical fluoroscope. Various size cones and diaphragms are available for fine radiographic work.

The feature of absolute silence combined with safety cannot be emphasized sufficiently. Other silent machines which are not completely

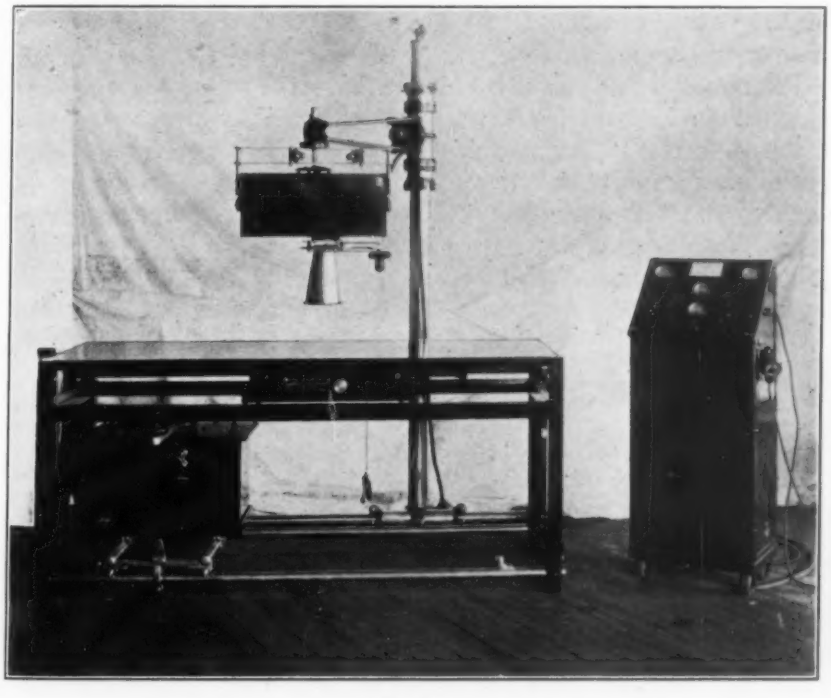

FIG. 7

New model x-ray table with flat Bucky transformer-tube unit above table on single upright support, instead of two uprights as shown in other illustrations of older model. This unit can be furnished with tilting attachments.

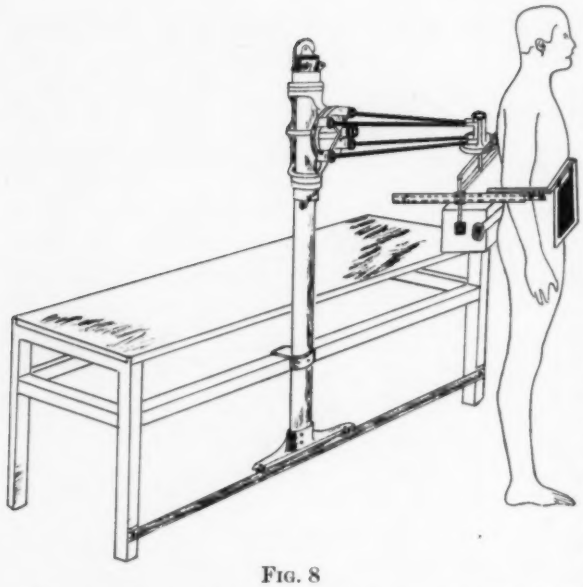

FIG. 8

Upper transformer-tube unit with screen adjusted for upright fluoroscopy.

oil-immersed and shock-proof constitute a potential menace. Both buzzers and red lights may be had to caution the patients to keep away from live parts, but accidents are prone to occur and increase the hazards of such silent apparatus. The combinations used in this unit are ideal and received enthusiastically by both patient and surgeon, who are unusually relieved by its silent operation and by the assurance that live parts are completely excluded from the apparatus. The surgeon, particularly, is gratified because he can move about in the darkened room during fluoroscopy with immunity and impunity.

For almost two years this unit has been the sole x-ray diagnostic equipment of a large private hospital in New York City with a very exacting attending staff. The machine has rendered perfect service in all types of radiographic work, including mastoids, sinuses, chests, gastrointestinal, and bone and joint conditions. Collaboration with several urologists in making urologic x-ray studies has resulted in extreme satisfaction and the combination of the biplane fluoroscope and the radiolucent fracture stretcher has been especially pleasing to surgeons and orthopaedists.

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JOINT SEQUESTRA OF OSTEOMYELITIS

BY ETHELBERT SPURRIER, M.D., DETROIT, MICHIGAN*

The surgical removal of sequestra of osteomyelitis has long been considered good practice, but the presence of sequestra is not always easy to determine. Phemister[1] has enumerated several rules for the recognition of dead bone based on pathological and roentgenological studies. He calls attention to the fact that a sequestrum bordering on joint cartilage in the presence of a complicating suppurative arthritis stands out prominently because of the preservation of its original density and because the bone supporting the articular cartilage due to its inaccessibility to granulations is not broken down, whereas the bone underlying the rest of the cartilage in the infected joint is usually irregularly broken down by granulations. We wish to consider this type of sequestrum further because it has distinctive pathological and roentgenological appearances and because it has not been adequately discussed in the extensive literature on osteomyelitis in recent years.

Klemm[2] states in a comparison of the sequestra of tuberculosis with those of purulent osteomyelitis that in the former there is a characteristic wedge-shape with the base of the wedge towards the joint and that the sequestration takes place much faster in purulent osteomyelitis than in the tuberculous form. But he goes no further in describing the pathological or roentgenological changes. Auchincloss[3] presented a case of wrist joint infection in which the os magnum showed the characteristic features of a joint sequestrum but there was no discussion of the changes in the bone after removal. Phemister[4] has presented an illustration and brief description of a case of join sequestrum occurring in the hip of a man forty years old.

In the course of an osteomyelitis involving a joint producing purulent arthritis, we occasionally see in the roentgenogram an area of bone bordering on the articular surface which has a greater density than the remainder of the bone of the joint. The dense area has its articular cortex intact, casting a heavy outline. The articular surface of the rest of the joint shows a reduction in density of the shadow cast by its cortex and an irregularity of the cartilage space. Away from the articular surface the area of greater density has a rather sharp but irregular outline, plainly demarcating it from the rest of the cancellous bone.

When examined pathologically, the reasons for the above changes which are apt to persist for a long time, become apparent. The smooth sharp surface seen in the roentgenogram is the articular cortex which at

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no place retains its cartilage. This is due to two factors: first, the death of the underlying bone, which ultimately becomes the sequestrum, interrupts the nutrition of the cartilage and, second, the pus that is present digests the dead cartilage readily. The latter processes have been explained in full by Phemister[5] in his work on the joint surfaces in tuberculous and pyogenic infections. The fresh denuded cortex is white or gray in color, devoid of blood supply, and is uneroded at its central portion by granulations which may be seen springing from the surrounding living bone. The granulations from the living bone on the opposite side of the joint do not bridge the joint space to attack the articular surface of the sequestrum. This is shown in Figure 2.

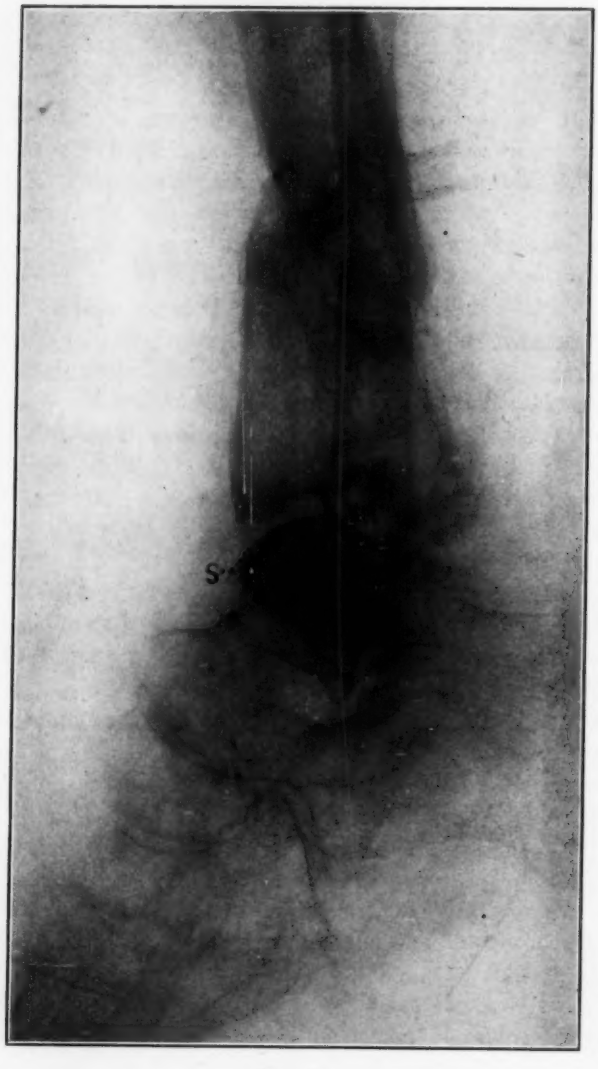

FIG. 1

Represents the changes present one year after a supramalleolar compound fracture of both bones of the leg followed by purulent arthritis of the ankle joint and osteomyelitis of the astragalus. It shows the sequestrum (*s*) as a dense area in the astragalus which elsewhere has undergone marked bone atrophy due to disuse. The articular cortex of the sequestrum is preserved and is sharply outlined. The remainder of the outline of the sequestrum has a well defined but irregular edge, the result of erosion by granulations from the infected living bone of the remainder of the astragalus.

The living bone adjacent to the sequestrum has a greatly reduced density because it has not lost its blood supply and has, therefore, been able to undergo absorption and atrophy due to disuse and erosion by granulation tissue. It continues to decrease in density as the period of inactivity and infection becomes prolonged, so long as its blood supply is able to carry away the lime salts in the process of

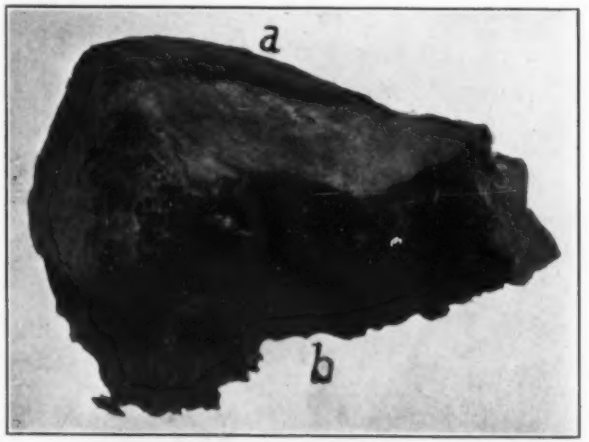

FIG. 2

Represents the sequestrum removed from the astragalus seen in Fig. 1. The upper gray surface is the articular surface seen so well in the roentgenogram. It presents intact subchondral articular cortex from which the cartilage has been removed by the digestion of the pus present in the joint. The lower dark irregular surface (*b*) represents the eroded cancellous bone which has been attacked by granulations extending into the sequestrum from the surrounding living infected bone.

FIG. 3

Eight months after the onset of an acute pyogenic osteomyelitis of the os calcis, the above changes were present. Here we see an extreme degree of bone atrophy due to disuse, with retention of the cortex and especially the articular cortex in all bones. The cortex is seen as a narrow rim about the periphery. In the joint sequestrum (*s*) both cortex and underlying spongiosa persist in their original density.

FIG. 4

This series shows the fate of a sequestrum in the head of the femur of a boy aged twelve. The end result was complete absorption six months after the onset of the infection.

FIG. 5

Infected gunshot fracture of the shoulder with arthritis. Duration two months. The detached fragment (*s*) shows no atrophy and its articular cortex is intact. The rest of the humeral head is atrophic and its articular cortex is obscured, due to absorption from arthritis. The fragment (*s*) was excised and was found to be necrotic with articular cortex intact and articular cartilage gone.

rarefaction. Articular cortex persists in atrophied bones and is seen as a narrow rim about the periphery. Both articular cortex and underlying spongiosa persist in their original density in the sequestrum. These points are well shown in Figure 3.

FIG. 6

Photograph of the upper end of a tibia showing suppurative arthritis of two and a half months' standing and a joint sequestrum (*y*), consisting only of the articular cortex of the external tuberosity. Arthritis was secondary to osteomyelitis of the tibia in a twelve-year-old boy. Thigh amputation.

Dense sequestra are apt to persist for several months and when not removed are apt to undergo absorption due to granulations spreading into the dead bone from the surrounding living infected bone. The erosion being from the cancellous side, the speed of absorption would then depend upon the amount of granulations coming in contact with the dead bone and the ability of these granulations to erode the dead bone. In general it occurs more rapidly in children than in adults.

Figure 4 shows a pyogenic infection of the hip and of the femoral head. Three weeks after the onset (*A*) there was no sequestrum. One month later (*B*) there was a definite sequestrum and a month after that (*C*) the sequestrum was considerably reduced in size. A roentgenogram taken six months later showed that it had been entirely absorbed.

The following fourteen cases have been collected from the surgical clinics of the University of Chicago. There are nine cases of direct joint involvement from osteomyelitis of the adjacent bone, one case of osteomyelitis following infection after panastragaloid arthrodesis, and four cases resulting from arthritis in which the joints were infected following gunshot or other open wounds. In this series the ankle was involved five times, the hip four times, the knee twice, and the shoulder, elbow, and phalanx each once.

In comminuted fractures of the epiphysis with open wounds and infection of the joint, the detached fragments of bone containing articular cortex may die and retain their original density similar to a joint sequestrum. Figure 5 shows an infected gunshot fracture of the shoulder with a fragment off the articular surface of the humerus which presents the roentgenological characteristics of a joint sequestrum. This type of sequestrum has been termed by White[6] "the primary sequestrum".

Axhausen[7] holds that the separation of the intra-articular portion of the distal end of the second metatarsal in Freiberg-Köhler's disease is the result of low grade bacterial embolism of the arterial supply of the area of bone and cartilage which becomes detached. He suggests that this may be the cause of loose bodies in joints in general and we may have an analagous process in joint sequestra with the more virulent organisms that go on to the formation of frank osteomyelitis. This is suggested

FIG. 7

Roentgenogram of the specimen shown in Fig. 6. The sequestrum of cortex (*s*) is denser than the adjacent atrophic living bone and its articular surface is smooth. Articular cortex of the mesial tuberosity has been destroyed.

in Figures 6 and 7. This is also in line with the elaborate diagrams of Wilensky[8] shown in an explanation of the various forms of osteomyelitis.

Figures 6 and 7 show a rare instance of necrosis of articular cortex of tibia with subsequent digestion of the articular cartilage and separation of cortex from the underlying cancellous bone of the epiphysis.

SUMMARY

When bone bordering on an articular surface becomes necrotic in osteomyelitis, it separates as a sequestrum which has the following characteristics:

1. It is denser than the adjacent living bone which undergoes atrophy.
2. Its articular cartilage disappears, being digested by the proteolytic ferments liberated in the joint.

3. The articular cortex of the sequestrum is preserved because of its inaccessibility to granulation tissues.

4. The articular cartilage and cortex of the rest of the joint, which is living, is usually lost. This gives the joint sequestrum a characteristic appearance which is easily recognizable in the roentgenogram as well as in the gross specimen.

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A SIMPLE ABDUCTION SPLINT FOR USE IN OBSTETRICAL PARALYSIS

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The value of relaxation splinting in the management of muscular paralysis is so well recognized that it seems hardly necessary to discuss at length the rationale underlying this measure. Unfortunately, too often the correct type of splint is applied late in the condition and much valuable time is lost before the involved muscles are put in the position most propitious for their recovery. Often the condition is not recognized until some time has elapsed after the development of the paralysis; at other times the correct position into which the muscles should be placed is not understood. There is also a tendency to wait in the presence of some slight, and possibly quite temporary, condition to see if it will not disappear and thus a valuable measure of treatment is delayed for several weeks. In the case of birth paralysis this tendency appears to be justified in that a large number clear up spontaneously in a few days or weeks. In a very temporary condition, however, correct relaxation of the affected parts will lead to more rapid recovery, while if the paralysis is of a more serious nature the sooner the treatment is started the better.

It is not the purpose here to discuss obstetrical paralysis any further than to indicate the reasons for the application of braces early in the condition, while the infant is but a few days old. Giliberti[1] says that brachial plexus paralysis is the most frequent cause of birth palsy. Most orthopaedic surgeons have also taken the position that a primary lesion to the plexus is present, and that pathology in the capsule of the shoulder joint is not the cause of the plexus injury. For details of the controversy concerning the different theories of pathogenesis of birth palsy the reader is referred to the papers by Boorstein[2], Platt[3], and Fairbank[4].

The condition occasionally follows normal labor; more often, however, it follows prolonged labor, especially in the presence of contracted pelvis in which some instrumental aid must be given. It occurs more often with head than with breech presentation. The injury is due to traction on the plexus and affects most often the upper cords or roots, less often the lower cords or the whole plexus. Sever[5] in an analysis of eleven hundred cases records the condition as upper arm type in 829, and lower arm or better whole arm type in 208; in sixty-seven instances the paralysis was bilateral. The upper arm, or Erb-Duchenne type affects the fifth and sixth cervical nerves and is evidenced by a flaccid paralysis of the deltoid, biceps, brachialis, brachioradialis, often the supinator, supraspinatous and infraspinatous, subscapularis, and teres major muscles. Due to this, the arm

lies loosely at the side in medial rotation and cannot be abducted. Sensory changes must be present, but cannot be easily demonstrated in the young patient. The Klumpke-Déjerine or lower arm type affects the seventh and eighth cervical and first thoracic nerves, and there is paralysis of the triceps, flexors of the wrist, the pronators, the flexors and extensors of the fingers, and the intrinsic muscles of the hand. The combined type has features of the two other types in various combinations.

The prognosis depends on several factors, most important of which is the extent of the lesion which may be very slight and consist of a slight tear in the sheath of the nerves with hemorrhage among the fibers, or quite severe with irregular tears at different levels of the plexus. Avulsion of the roots from the cord may occur. Regardless of the initial extent of the lesion, proper relaxation of the plexus tends to prevent increase of the damage, and support of the muscles prevents their being overstretched by the overaction of the opposing groups.

It is advisable to start orthopaedic treatment as soon as the condition is recognized, a point made by Mooney[6] and Boorstein[2] who says, "The best results in all these injuries can be obtained if the treatments are instituted early. The obstetric services of the general and special hospitals should include in their armamentarium the orthopaedic appliances to institute early treatment."

The splint described below was devised to give immediate support to the arm, forearm, and hand in a recent case of Erb's paralysis. Fortunately the condition cleared up in a few weeks, the use of the apparatus was discontinued, and the child at the age of six months (Fig. 3-*B*) has perfect use of the arm. It is believed that the splint would prove valuable as ready available equipment in any obstetric ward. It can be applied to infants one or two days old (Fig. 3-*A*) and can be removed as often as required for inspection. Should the condition prove to be of temporary nature certainly no harm has been done and the infant should recover more quickly from the injury. If the paralysis is more serious the correct treatment has been started at once, and the injury to the nerves may be prevented from increasing in extent. If it is necessary to wear the splint for several months one of larger size can be easily made.

The splint is illustrated in Figures 1 and 2. It is made of hard sheet aluminum, No. 2SH, 0.081 inch in thickness, which can be readily cut with tinners' snips and rounded-out into proper shape with hammer and anvil. It is an adaptation of the familiar airplane splint. The details of the metal work are shown in Figure 1.

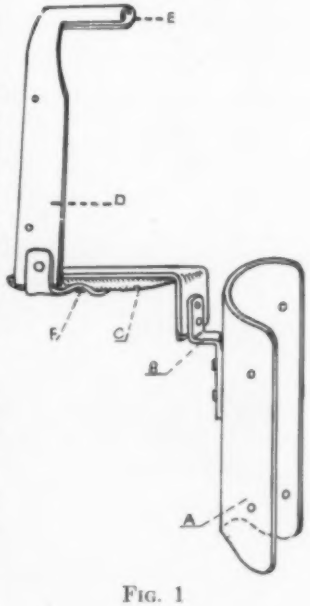

FIG. 1

FIG. 2

A is a rectangular plate made to fit the lateral surface of the body, extending from the anterior to posterior axillary lines in its lateral extent and from the crest of the ilium (where it is slightly indented) to the axilla above in its vertical extent. The piece supporting the arm (Fig. 1-*C*) does not extend clear to the axilla but is fastened to the body plate by means of a separate metal plate (*B*), which holds it away from the axilla which is thus free and more easily kept clean and dry. The forearm, wrist, and hand support (*D*) is essentially the type of splint described by Kanavel[7] and Koch[8]. The plate is made so that it extends from the elbow to the metacarpophalangeal joints and is bent at the wrist to keep the hand dorsiflexed. Distally the metal is rolled over itself to form a tube (*E*) on which the fingers grasp and which keeps the thumb away from the palm, in the "position of function", as recommended by Kanavel[7]. The forearm plate is fitted to the arm plate by means of a bar of metal (*F*) which allows rotation so that pronation or supination may be obtained. The arm and forearm plates are rounded out to conform to the roundness of the baby's arm. The splint is padded with piano felt, except over the forearm plate which is covered over with fine, smooth leather.

The apparatus is held in place by means of leather straps as shown in

FIG. 3

A. Illustrating application of splint; no evidence of discomfort or annoyance.
B. Child (for whom splint was originally made) at the age of six months with free, full use of the arm.

Figure 2. Over the side of the body opposite to that on which the metal plates rest there is a large oval piece of fairly thick leather (*A*) over which run two straps to encircle the body. These straps are attached to the body plate (*C*) by means of buckles. A smaller leather plate (*B*) fits over the sound shoulder and from this straps run vertically downwards to the uppermost of the bands encircling the body. Two other straps run obliquely to the metal body plate, where they are attached by buckles. Smaller straps serve to hold the apparatus to the arm. All of the straps are well padded with felt, and none runs over the affected shoulder where pressure is to be avoided.

The apparatus holds the shoulder in abduction, thus relaxing the deltoid and supraspinatous muscles, and in lateral rotation relaxing the infraspinatous and teres minor. Flexion of the forearm relaxes the biceps and brachialis. Supination is obtained by rotating the forearm plate as desired and the hand is held in the position of function. It is surprising to see how placidly the infant wears this splint (Fig. 3-*A*); there is no evidence of annoyance or irritation occasioned by the apparatus. Although a plaster cast could be applied to act in the same manner, this splint has the advantage that it can be removed at frequent intervals (every day by the mother for bathing the baby), the arm inspected, and massage and other indicated treatments carried c Associated pathology, such as fracture, must of course receive proper ention.

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REPORT ON TWO CASES OF BONE ANOMALIES

BY JOEL C. SWANSON, M.D., FARGO, NORTH DAKOTA

From the Section of Orthopaedic Surgery, Fargo Clinic

Case 1

M.G., female, age sixteen months. Admitted to Clinic because of limp and atrophy of left foot.

Family History. Father has pulmonary tuberculosis, supposedly contracted during war service. Parents married three years, no miscarriages, no other children, no history of faulty development in parental families.

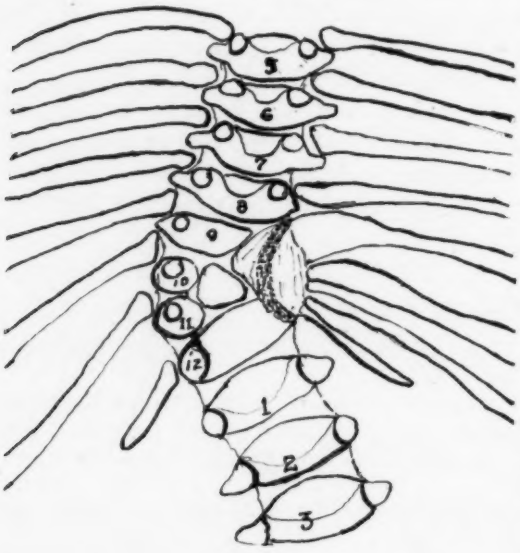

Fig. 1

Case 1. Congenital scoliosis showing fusion of parts of the ninth, tenth, eleventh, and twelfth dorsal vertebrae.

Past history. Have always noted deformed foot; otherwise child has been normal. Seriously ill during infancy, cause unknown. No history of tuberculosis, infantile paralysis, or the ordinary diseases of childhood.

Present history. At the time the child began to walk it was noted that she limped and had a tendency to fall, being unable to go six feet without stumbling. This was thought to be due to the fact that the left foot was smaller than its mate. As the condition did not improve, she was brought to the Clinic for advice and an examination, no attention being called to other parts of the body.

Examination. Well-nourished child, good color, clear skin. Normal mentality. When the child was stripped, it was noticed that she had a right dorsal scoliosis. This was demonstrated to be organic and x-rays were taken. There was a large patch of long brown hair over the lower dorsal vertebrae, suggestive of spina bifida over the scoliotic area. When the child attempted to walk there was a falling of the spastic left knee towards the left side. There was no demonstrable shortening of left thigh or leg, but there was marked atrophy of left foot, which did account for one-half to three-quarters of an inch shortening of left extremity. The circumference of both legs was the same except in the feet, where again the left was markedly smaller than the right. The child was otherwise physically sound.

X-ray report. "The spine shows a right-side scoliosis with greatest deviation at the level of the eleventh dorsal vertebra. No atrophy. No evidence of bone-tissue destruction. The bodies of the ninth, tenth, and eleventh vertebrae are deformed. The ninth shows an absence of about one-third of its body on the left side, while the tenth shows an absence of about two-thirds of its body structure on the right. The

eleventh is divided into three equal parts. They all show a regular uniform outline and a normal bone-structure shadow. The disc spacing between these defective vertebrae is well defined but narrow. The ninth, tenth, eleventh, and twelfth vertebrae are united and reenforced on the left side by a natural splint of new bone tissue. These findings would support the conclusion of a congenital defect in the development of the spine." *Dr. T. P. Rothnem.*

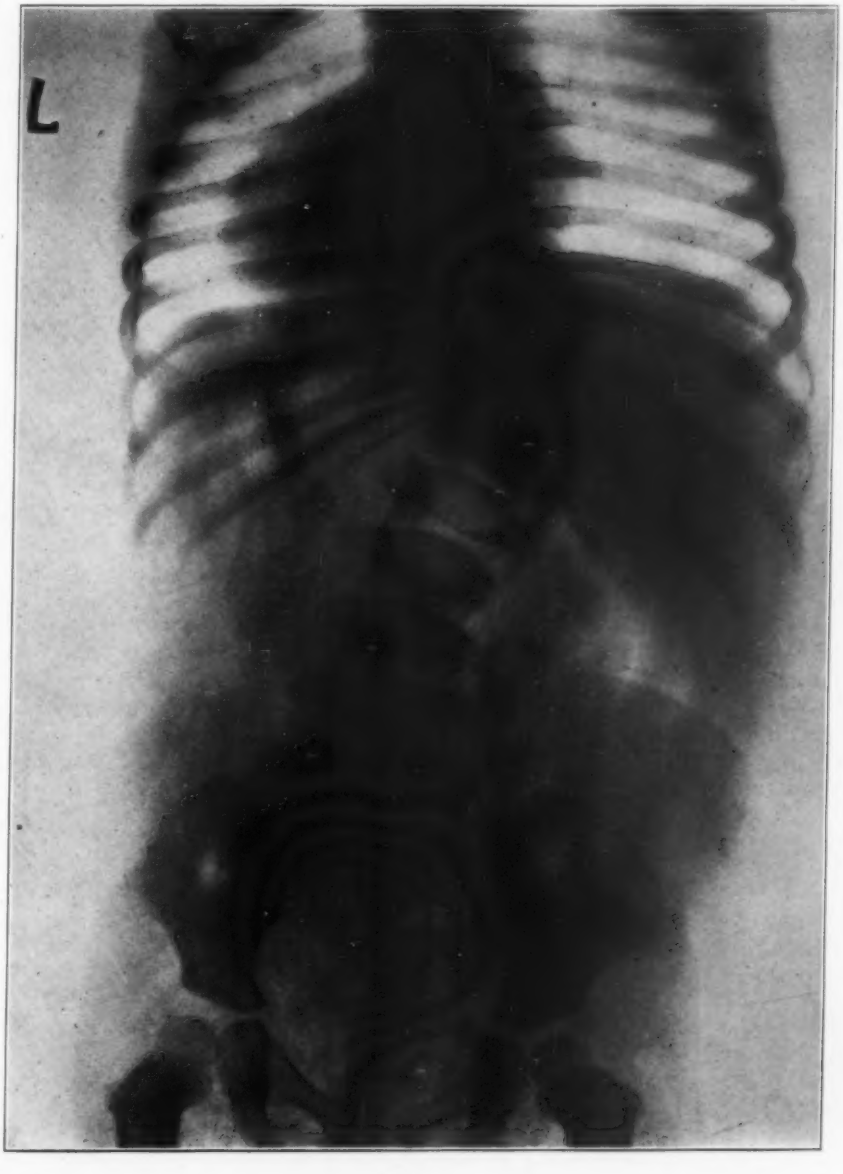

FIG. 2

Case 1. X-ray film showing fusion of ninth, tenth, eleventh, and twelfth dorsal vertebrae.

Conclusion. Unfortunately the child was taken to another state before we were able to conclude our examination or to secure plates of atrophied foot and other parts of the body. During the severe illness which the child had soon after birth, she had very good medical supervision and subsequent to that time also had very good attention, but at no time was any pathology noted in the spine. The nature of the growth of the vertebrae and the union of the transverse processes and bodies on the left side would indicate that this is of a congenital nature.

Case 2

K.L., male, age fourteen. Admitted to Clinic because of protuberance of left costal sternal border and to obtain advice as to whether condition could be corrected or further deformity prevented.

Family history. Father had similar deformity, but much less permanent, now hardly noticeable. No treatment was ever given, natural growth partially correcting deformity; history otherwise negative.

Past history. No history of acute illnesses, especially that of rickets.

Present history. The protuberance on the right side of the chest at the costosternal margin has been noted for several years, but has become much more marked in past year, increasing with boy's growth. He has added about five inches to height in that time. The deformity does not give any clinical symptoms except a slight shortness of breath on exertion.

Examination. A well nourished boy, showing signs of rapid growth and changes associated with puberty.

Inspection. Reveals a marked protuberance along lower two-thirds of right sternal margin, but raised about three centimeters and about four centimeters broad. No other deformities found.

Palpation. The raised area apparently involves the costosternal articulation and part of the right half of the gladiolus of the sternum.

X-ray report by Dr. T. P. Rothnem.

The sternum shows absence of bone-tissue union between manubrium and gladiolus, also between the four segments of the gladiolus and gladiolus and ensiform. There is also a mesial vertical line showing absence of fusion between the lateral halves of all the segments of the gladiolus. This indicates a non-fusion of the six developmental sections of the sternum.

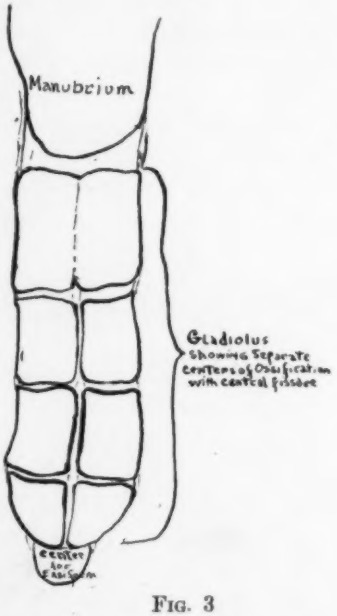

Fig. 3

Case 2. Front view of sternum. Tracing of x-ray.

Conclusion. A congenital bone anomaly in which the gladiolus of sternum has bent at the midline between its centers of ossification, rather than at its costosternal attachment. The gladiolus is usually formed from four centers, but there may be additional centers placed laterally; this accounts for the vertical fissure which occurs in this case. These centers and separate segments begin fusion at puberty, which is complete at about the age of twenty-five. The unusual point in this case is that the give should be at the midline of the sternum rather than at the costosternal articulation. The fact that the father had a similar deformity would indicate a familial fault.

HODGKIN'S DISEASE
AN ORTHOPAEDIC PROBLEM

BY WALTER P. BLOUNT, M.D., MILWAUKEE, WISCONSIN

A puzzling clinical picture which was first described by Hodgkin in 1832[1], and since then studied and clarified by many medical men and pathologists, has recently been recognized as one of the problems confronting the bone surgeons. The peculiar hypertrophy and metaplasia of the cervical, mediastinal, and other lymph glands was at first not differentiated from the enlargement of these glands in lymphosarcoma, tuberculosis, and the leucaemias. Later, cases presenting symptoms of intermittent fever, anaemia, and enlargement of the spleen and lymph glands, coupled with degeneration of the hemopoietic structures and appearance of Dorothy Reed cells and eosinophils, were grouped under the name lymphogranuloma. This disease was variously thought to be due to a specific bacillus, the tubercle bacillus, or to a neoplasm.

In the exhaustive investigation of cases, the osseous system was at first only casually examined. Hyperplasia and degeneration of the bone marrow and thinning of the cortex were noted as a part of the hemopoietic involvement. Ziegler[2] believes that in thirty to forty per cent. of the cases there is bone involvement, and Symmers[3] finds it in every case. Düring[4] quotes Askonazy in saying that bone involvement would be found if looked for. Symmers, Düring, Montgomery[5], and Robinson[6] have cited cases in which the spine was involved with findings and symptoms somewhat suggestive of tuberculosis.

Weber and Ledingham[7] showed x-rays in which a generalized periostitis appeared in addition to the medullary involvement. More recently a number of writers have reported cases in which the most prominent symptoms have occurred in connection with the skeletal system with absence of some of the typical findings. In Montgomery's case there were osteoperiosteal tumors of the cervical spine and right tibia. Robinson observed the involvement of several vertebrae, leading to a transverse myelitis. In both cases, radium therapy relieved the symptoms temporarily. Weber reports another case[8], in which paraplegia resulted from vertebral periostitis and encroachment on the spinal canal by lymphogranulomatous tissue. Cone[9] reports the enlargement of one rib by new bone formation. The bone marrow was typically metaplastic.

The case reported is unique in that the bone involvement preceded the lymph gland enlargement by two years. Interesting errors in diagnosis were made because of the absence of the usual symptoms.

FIG. 1

X-ray of spine, suggestive of tuberculosis. Note, however, the destruction of the bodies of the vertebrae with preservation of the intervertebral discs.

CASE SUMMARY

H.B., female, age seventeen, Bone Sarcoma Registry No. 779, was admitted to the Wisconsin General Hospital on November 28, 1925, with pain in the back, of six months' duration. This had gradually increased in severity until July 1925 at which time a dorsal gibbus had appeared and the patient had been confined to bed. An x-ray had been taken by a local physician and a diagnosis of Pott's disease made. A body cast had been applied and left on for thirteen weeks. It had afforded some relief from the pain.

On admission there was an exaggerated dorsal kyphosis most marked at the eighth thoracic spinous process, and a compensatory increase in lumbar lordosis. There was some tenderness on palpation of this region but no pain on vertical percussion of the spine. Motion in the thoracic spine was restricted in all directions and the sacrospinal muscles were in marked spasm. There was no indication of abscess formation. The usual reflexes were normal and sensation was unimpaired. Physical examination was otherwise negative.

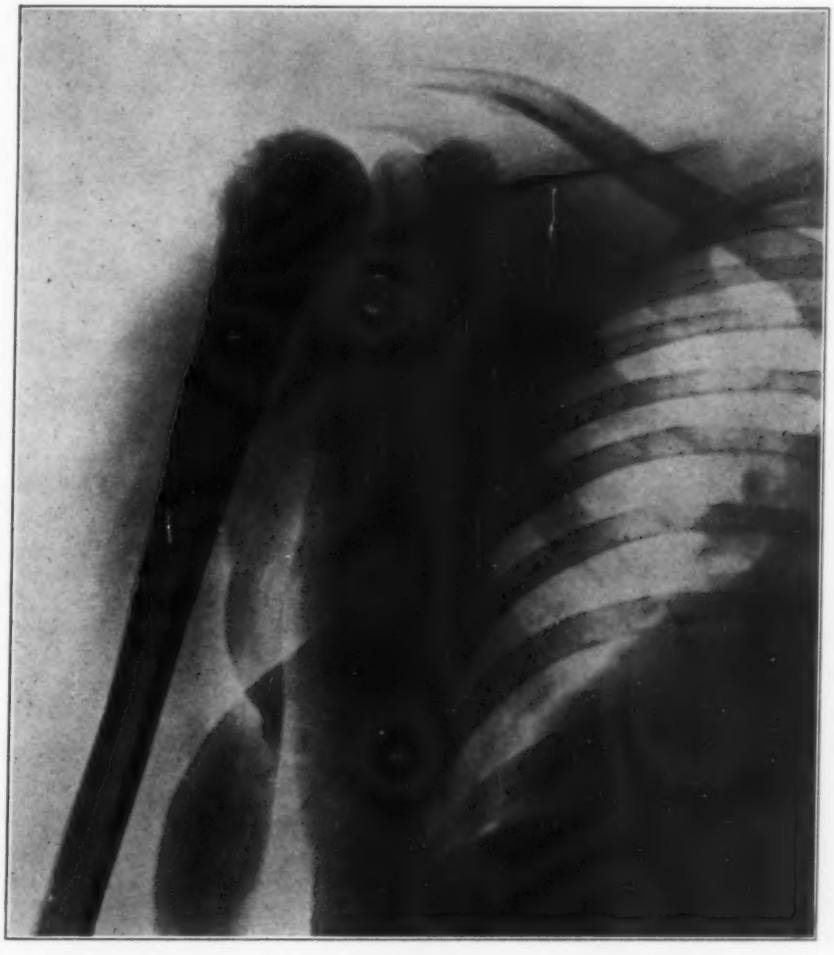

FIG. 2

X-ray of the left shoulder. Destructive lesion of the humeral head.

X-ray showed compression with bone destruction of the seventh and eighth thoracic vertebrae with slight decrease in the intervertebral spaces. The lateral view showed a moderate kyphosis (Fig. 1). X-ray of the chest was negative.

The blood Wassermann was negative. There was a trace of albumin in the urine. The white count was 13,000. The laboratory examination was otherwise unimportant.

The diagnosis of Pott's disease was confirmed and on December 9, 1925, a spine graft was done by Dr. F. J. Gaenslen according to the Albee technique. The patient made a rapid, uneventful recovery, and with a Taylor brace had no complaint until January 28, 1926. Then, for the first time, she called attention to soreness of the left shoulder. There had been an injury in the spring of 1925 with some tenderness for a few weeks following. There had been no trouble since and she had not thought the disorder worth mentioning. There was now tenderness over the head of the humerus, but no redness, heat, or swelling. Flexion to forty-five degrees and abduction to ninety degrees was possible with pain. There was no enlargement of the axillary lymph glands. X-ray showed extensive, patchy bone destruction of the head and upper six centimeters of the shaft of the left humerus (Fig. 2). A diagnosis of caries sicca was made. An abduction splint was added to the Taylor brace and the patient allowed to go home with instructions as to general antituberculous measures.

She returned for observation on September 9, 1926. The symptoms had increased in severity and although the x-ray showed no advance in the process, a biopsy was done. Instead of the normal joint capsule a fleshy growth with a very thin covering of fibrous tissue was encountered. Gross examination was not conclusive. Microscopic examination led to the report of myxosarcoma (Figs. 3-A and 3-B). X-ray examination of the chest and routine examinations were again negative. There had been no loss of weight.

The diagnosis and prognosis were changed, but the patient was given the benefit of deep x-ray therapy and Coley's toxins. Some pain and limitation of extension developed at the left hip. X-ray of the hip was negative. Under the influence of deep x-ray the disability entirely cleared up. To the surprise of everyone the symptoms at the left shoulder also cleared up until the left upper extremity could be moved without restriction. X-ray was continued for several weeks after the symptoms had disappeared and the patient then was allowed to go home.

She returned to the hospital on December 12, 1926. She was still entirely free from symptoms. The results of the Albee graft were satisfactory. A hard spherical mass, the size of a hickory nut, was discovered at the right extremity of the isthmus of the thyroid. A softer mass of the same size and freely movable had appeared under the scalp at the bregma. At either angle of the mandible was a large group of firm lymph glands and those of the anterior cervical chains were enlarged. The axillary glands were normal in size. There was no enlargement of the head of the left humerus and there were no other masses. X-ray of the chest was negative and there had been a gain in weight. X-rays of all of the long bones were negative.

In view of the absence of metastases and the marked remission under deep x-ray therapy, the diagnosis of sarcoma was questioned. Slides and x-rays were sent to Drs. Ewing, Phemister, Codman, Mallory, Parker, and Simmons. Their opinions were as follows:

May 25, 1927 "I believe the tumor should be classed with the Ewing tumors. It is made up of a mixture of connective tissue and round cells, and Ewing feels that round cells are endothelial in origin and calls the condition endothelioma, as you know. I do not believe they are endothelial cells. The Germans have called the condition multiple myelogenous sarcoma."

D. B. Phemister.

July 8, 1927 "I have marked one section+ and made an ink circle within which the cells suggest hypernephroma. I suppose Mallory will say they are due to poor fixation. I do not think Ewing will acknowledge this as one of his endotheliomas."

E. A. Codman.

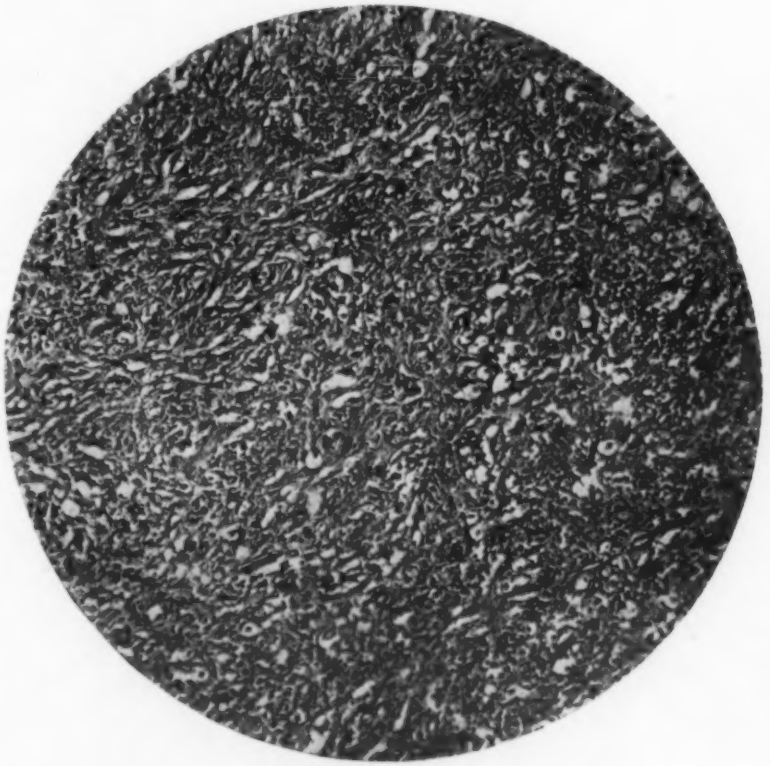

FIG. 3-A

Section from the left shoulder magnified 100 times.

FIG. 3-B

Section from the left shoulder magnified 430 times.

July 21, 1927 "Rapidly growing tumor, numerous mitoses. Tissue poorly preserved. Diagnosis: Malignant tumor."

F. B. Mallory.
F. Parker, Jr.

July 27, 1927 "Ewing's sarcoma"..... *C. C. Simmons.*

"Very peculiar case. Probably some form of myeloma. Cannot accept it as endothelial myeloma."

J. Ewing.

FIG. 4
Section from the tumor of the scalp magnified 100 times.

The facts were reconsidered and a tentative diagnosis of "endothelioma" made. The tumor of the bregma increased in size and became attached to the deep layers of the pericranium. The tumor of the thyroid gland became four times its original size, and nodular. It was not tender and was freely movable with the thyroid. The posterior chains of the cervical lymph glands were diffusely enlarged. There was no enlargement of the axillary glands. On April 15 the tumor of the scalp was removed by electric cautery. The patient made an uneventful recovery and there was no recurrence. Microscopic examination showed the tumor to be rather unlike the previous sections (Fig. 4).

On April 30 the thyroid gland was removed as completely as possible. It was found to be largely replaced by tumor tissue which was adherent to the trachia and could be removed only with great difficulty. Microscopic sections of the tissue showed a

FIG. 5

Section through the small bowel from postmortem examination, magnified 100 times.

structure similar to that of the tumor of the scalp. Slight hoarseness which had appeared previous to operation cleared up. There was no recurrence. A course of deep x-ray therapy was given and the patient allowed to go home at her request.

She returned to the hospital on October 31, 1927, admittedly much worse. There had been no recurrence at the sites of operation, but there was considerable increase in size of the left axillary glands with some limitation of motion at the left shoulder. There was a tumor mass in the left lower quadrant and extending above the crest of the ilium. This was firmly adherent to the bone and was firm and fleshy. X-ray of the chest showed no metastatic growths.

A course of deep x-ray therapy and Coley's toxins was begun. The patient had a violent reaction following each, however, and they were discontinued. The tumor of the pelvis increased rapidly in size and became very painful. Obstinate constipation ensued. Extreme weakness appeared, and after a few hours of semicoma, the patient died on December 10, 1927.

An autopsy was performed on the same day. An abstract of the report includes the following relevant findings:

There were healed scars of operations for spine graft, thyroidectomy, excision of the scalp tumor, and exploration of the left shoulder. Large, firm, discrete glands were palpable in the neck, axilla, and epitrochlear and inguinal regions.

A small, round area of rarefaction was found on the inner table of the vertex of the calvarium. There was no lesion of the brain, but opposite this area the dura was thick

FIG. 6

Section of a lymph gland from postmortem examination, magnified 100 times.

in an irregularly oval patch of granulations. Several dorsal spinous processes were fused by a bony bridge, but the cord was normal in this region.

There were firm masses as follows: between the liver and the lesser curvature of the stomach, along the lumbar spine and into the pelvis and left inguinal region, and at the ileocaecal junction. Smaller masses were present in the gut and mesentery, and along the aorta. The lungs were normal except at the left hilus. Here and in the mediastinum and neck, there were large firm masses. Some nodules were discrete and some confluent.

The right auricle was dilated. The liver and spleen contained no nodules. The kidneys and adrenals were normal. The stomach and urogenital organs showed no change. In the wall of the small bowel, beginning sixty-five centimeters from the pylorus, were found numerous gray flat nodules,—in all about twenty. They did not perforate the serosa, but the mucosa over them was thin and atrophic. They were circular and averaged two centimeters in diameter by six-tenths of a centimeter thick (Fig. 5). The mass at the ileocaecal junction was the size of an orange and appeared to be formed of confluent nodules. The large bowel was not involved.

The head of the pancreas was involved in a gray homogeneous mass which pushed it up behind the stomach. The edges were rounded and the peritoneum loose. The aorta was normal, but at its lower end it penetrated a retroperitoneal tumor, which followed the left psoas muscle into the pelvis and thigh. The left ureter was surrounded by the mass, but was not constricted. There were similar but smaller masses (two and five-tenths centimeters in diameter) along the course of the aorta. In some the demarcation between tumor and the lymphoid tissue was clear.

Microscopic examination of the tumor tissue showed it to be made up of small and large cells. Some of the large cells had relatively large, hyperchromatic, irregular nuclei with scant rims of eosin-staining cytoplasm. The small cells had hyperchromatic nuclei and varying amounts of cytoplasm. Mitotic figures were occasionally seen. The cells had infiltrated the capsule of the node (Fig. 6). In areas the connective tissue of the node was swollen and hyalinized, and there was a diffuse fibrosis of the gland. There was a white thrombus in one of the larger veins at the periphery of the node. Phagocytosis by the reticulo-endothelial cells was considerable. In a part of one node not involved by the tumor, there was complete exhaustion of the lymphoid elements.

The lungs were free except for a tumor mass at one hilus. Here the tumor cells had invaded the alveoli. There was no lesion in the pancreas except for invasion by the tumor in one area. Here there was diffuse infiltration with atrophy and disappearance of the parenchyma. The wall of the small bowel was infiltrated with cells as described under tumor, and there was atrophy of the mucosa. The lymph nodes were filled with cells as described under tumor, and these had invaded the capsule and tissues surrounding the nodes. There was a diffuse fibrosis of the glands. Except for secondary changes, the liver, spleen, heart, kidneys, and adrenals were normal.

Additional laboratory findings were as follows:

The urine was negative for Bence-Jones' albumose on repeated tests, although there was a trace of albumin on two occasions.

Blood counts were not significant except for the increase of the eosinophils.

Date	11/28/25	12/21/25	2/2/26	9/18/26	4/11/27	11/1/27	11/30/27	12/5/27
Hemoglobin	70	52	57	73	67	60	70	39
Color index	.7	.5	.6	.7	.7	.6	.9	.4
R. B. C.	4,860,000	4,860,000	4,400,000	4,840,000	4,639,000	4,460,000	3,820,000	4,230,000
W. B. C.	13,000	15,400	15,300	10,050	6,650	6,300	5,500	6,250
Neutrophils	66.2	67.0	63.0	73	82	76	67	76
Eosinophils	1	2	2		5	9	5	
Basophils	.4						1	
Small lymphocytes	24.2	25	30	27	12	12	13	22
Large lymphocytes	3.8	3	1			1	10	2
Large monocytes	4.4	3	4		1	2	4	

CONCLUSIONS

The discussion of such a case is difficult. It is hard to reconcile the appearance of the early tumor and its differentiation towards connective tissue with the later sections having the characteristics of a lymphosarcoma. The variation in the picture suggests the presence of two processes. One is reminded of Ewing's statement[10] that, "The transformation of Hodgkin's granuloma into a sarcomatous process occurs in a certain proportion of cases". One is led to wonder if the reverse may be true. The postmortem findings are those of a proliferative or lympho-sarcomatous type of Hodgkin's disease.

Similar cases have been reported in which the identity of the process was early established by the appearance of the characteristic glandular enlargement. If reviewed in the reverse order of events, the case of H. B.

is rather typical. As the case actually developed, the stroma of the lymphatic tissue predominated in the early stage, giving a confused picture in the bones. Later, in the enlarged lymph glands there was more lymphocytic proliferation and the true diagnosis could be made.

The temporary success of x-ray therapy and the failure of the tumors to recur after removal, are significant in the treatment. The case is reported with the hope that orthopaedic surgeons may recognize the occurrence of Hodgkin's disease in the skeletal system, and earlier realize the possibilities of diagnosis and treatment.

SUMMARY

1. Skeletal involvement in Hodkgin's disease is much more common than has been realized, and may be primary.

2. Bone changes vary from degeneration of the bone marrow to bone destruction and production.

3. Hodgkin's disease may simulate tuberculosis of the spine and bone tumors.

4. Deep x-ray therapy is of benefit in retarding the progress of the disease.

The author wishes to thank Dr. D. B. Phemister of Chicago, and Dr. C. H. Bunting of Madison for their help in the study of the case.

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A CANVAS HAMMOCK

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A canvas hammock has been devised to be used with a Hawley table which has been found to be both practical and economical, and which materially aids in applying plaster-of-Paris bandages to the torso and extremity and in the making of plaster-of-Paris shells.

The hammock, as patterned (Fig. 2), is made from a good quality of stout canvas. It measures seventy inches in length and for adults is twelve to fifteen inches in width (for children, six to ten inches in width). The ends are turned back and secured to form loops that will permit a metal rod to be slipped through. For the new type of Hawley table, one end of the canvas is folded back and strongly secured to form a twelve-inch pocket with a hole cut in the mid-end for the passage of the head support rod. One end is cut back to form a *V* twenty inches deep, and the raw edges are bound with stout tape to prevent chafing of the skin. Figure 2 illustrates the making of the canvas for both the old and the new Hawley table; it also illustrates how the canvas can be cut, if necessary,

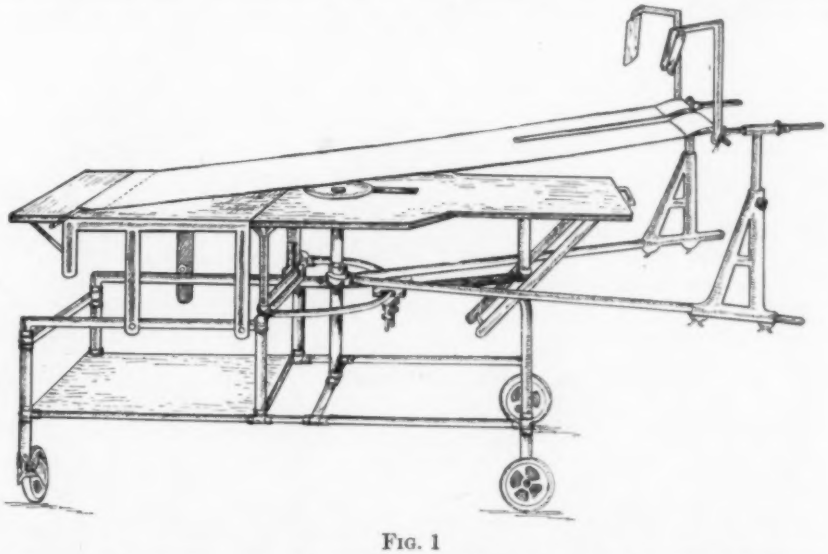
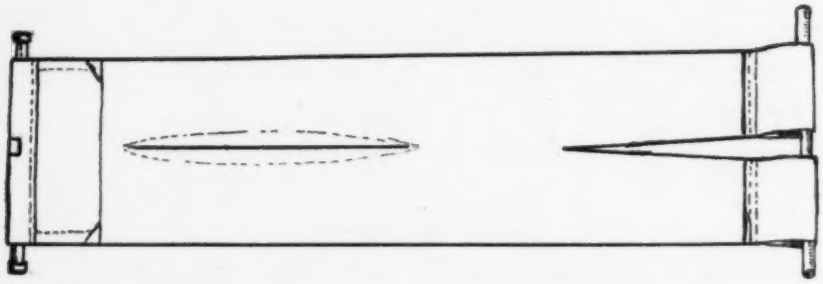


FIG. 1

Hammock in position on old style Hawley table. Note that the canvas is placed reverse to ordinary use of table—head at the foot. The standards are elevated to show degree of hyperextension obtainable. If greater length is needed, the standard supports can be removed from the support rods and reversed, thus adding from four to six inches length.

The saddle should be removed before lowering the table top. The transverse bar should be tied in place with muslin bandage.



Adult	Large	76"x15"	Children	large	76"x10"
"	Medium	76"x13"	"	Medium	76"x8"
"	Small	76"x10"	"	Small	76"x6"

FIG. 2

Illustrates how to make the canvas for both old and new style Hawley tables. The fold back for the new table should be secured at the corners with copper rivets—the notch in the unsplit end is necessary for brace rod. A special screw is necessary to hold the back rest on new style tables.

when applying plaster to include the thigh, this latter opening being held open when necessary by an assistant or by means of wooden spreaders.

No new attachments are required; the center rod and suspension pieces, which are standard with the table, may be used for the ends. For neatness and ease in applying (See Figure 2), it is well to have two pieces of gas pipe cut (twenty-four inches long and one-half inch in diameter) to supplement these.

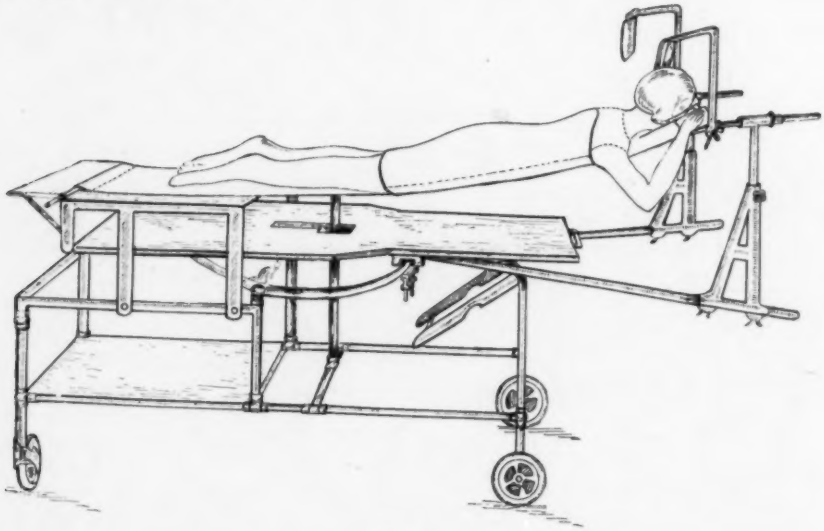


FIG. 3

Illustrates torso cast and shell—the dotted lines indicating extension of plaster over the shoulders and line of trimming to provide comfort. Before removing patient from hammock the table is raised to normal position, then tension is removed by unscrewing hand taps to lower onto table top, both rods being withdrawn before turning patient.

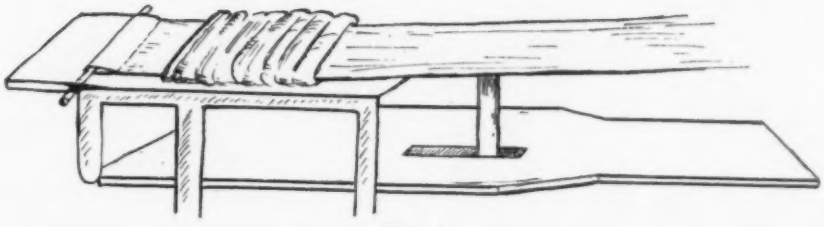


FIG. 4

One layer of stockinet is threaded over the canvas before securing in place. This provides the skin covering of the torso cast or shell. It can be pushed to the patient's feet until needed.

In using the hammock for a non-operative case, the lower end of the canvas is secured by passing the canvas through the opening between the head end of the table and the head rest. A rod is now slipped through the loop and when pulled tight will be found to hold (On the new type table the folded end is simply hooked over the end of the table as an envelope). In the new type Hawley table it has been found necessary to provide a thumb screw through the sliding shoulder rest rod to prevent the shoulder support of the table from sliding forwards and blocking the raising and lowering of the table.

The long stirrup bars are now swung as near together as possible and secured in place by tightening the attachment screws. The stirrup support rods are swung up (as shown in Figures 1 and 3) and the extension bars elevated as high as desired, depending upon the degree of hyperextension required in the individual case. The bar is now passed through the ends of the canvas and adjusted behind the stirrup bar upright, and secured in place with a few turns of muslin bandage. This latter precaution is absolutely necessary to safeguard possible rotation and slipping where one has failed to definitely secure all lock bolts and nuts. The screw traction bolts, having been previously lengthened to the limit, are now tightened to give the canvas the desired tension. The canvas is now hooked up in reverse to the usual use of the table, the head of the patient being at the foot of the table (Fig. 3).

When the hammock is to be used post-surgically or with an anaesthetic, it is arranged before the operation is started. Two coverings of stockinet are used; one is placed around the canvas and slid down out of the way (Fig. 4), the other is applied to the patient, thus placing the canvas between two layers of stockinet, which

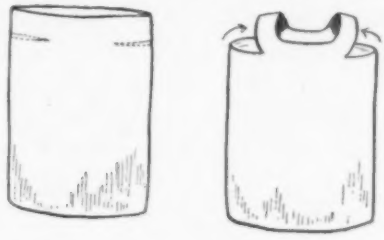


FIG. 5

Two layers of stockinet are needed for each cast. The figure to the left shows method of cutting the shoulder strap by cutting both thicknesses of the stockinet about two inches from the edge inwards from two and one-half to four inches, according to the size of the patient. The figure on the right shows the straps turned up. The arm is passed through the opening indicated by the arrow.

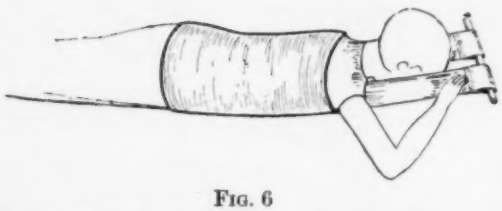


FIG. 6

Illustrates a torso cast with face in position for anaesthesia. The arms can be held in place by outing flannel loops placed about the wrists and secured to the uprights.

greatly facilitates its easy removal (Fig. 7). When surgery is completed and the patient ready for plaster, the stirrup pieces are raised as high as they will go and the tension of the canvas is then increased by turning the swivels on the traction bars. This can be done with greater ease if the weight of the patient is taken off the canvas by an assistant lifting the patient gently upwards by passing his arms under the canvas and the patient's torso. The face is passed through the *V* slit and the anaesthetic continued. The table top is lowered permitting ample room for sag and casting.

Excellent torso jackets and shells can be made with the apparatus (Fig. 6). In applying a shell, a felt lining is first made which fits the patient accurately. Saddler's felt, generally one-half the thickness of the commercial felt, in a piece of sufficient width and length (reaching from the top of the head to the knee) is placed over the patient's back. As shown in Figure 3, it is rounded out at the neck and over the shoulders, permitting the ends of the felt to fall down to the canvas on each side of the neck; a section is then removed from the small of the back, sufficient to cause the felt to fit snugly into the body; this is now sewed together to assure smoothness in the felt lining, and a layer of stockinet is pulled over the patient to hold this felt in position. Using six-inch to eight-inch width plaster bandage, the shell is made to extend from the knees to the top of the shoulders by first running the bandages lengthwise and then crosswise, molding same into place as applied. Care should be used to get sufficient strength in the shell at the shoulders. Knee space must be watched and maintained by placing a folded towel between the knees.

After building the plaster bed of sufficient thickness it is permitted to harden. The stockinet is now cut through beneath the canvas hammock and the completed shell with felt lining is removed *en masse* from the patient. It is trimmed at once to fit at the neck, shoulder, and sides.

FIG. 7

Removal of canvas from torso jacket. If sheet wadding is used the canvas can be freed by passing a thin board along face of canvas, thus detaching it from the cast. It is removed by pulling from below downwards.

Figure 7 illustrates the method of removing the canvas for torso casts. Where

casts extend down the thigh for spica use, the canvas will, of necessity, be sacrificed by cutting away.

Shells and jackets made in this way are very comfortable and satisfactory. The advantages of the apparatus over those in prevalent use are as follows:

(*a*) No additional tables or special attachments are required for its use. The standard Hawley table equipment is all that is required. (The two gas-pipe rods in addition are advised.)

(*b*) The hammock is long enough to cover the entire table and no metal parts are in contact with the patient.

(*c*) Varying degrees of hyperextension may be readily obtained, as desired.

(*d*) It is inexpensive.

(*e*) The table can be completely prepared before an operation and thus the applying of the plaster be expedited.

(*f*) It permits a complete drying of a torso cast without compressing it over the abdomen and gives ample opportunity to carefully mold the cast to shape.

(*g*) Transferring of the patient or changing position on the table is unnecessary.

SUMMARY

A hammock attachment for Hawley tables is presented for use in making plaster jackets and shells with illustrations showing its construction and use. Surgeons who have used this device have found additional merit in its use, especially in fixation of extremities after pedicle grafts.

THE SHOULDER SPICA: A NEW APPARATUS

BY A. P. MACKINNON, M.D., C.M., F.A.C.S., WINNIPEG, MANITOBA

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The application of a shoulder plaster spica to an anaesthetized patient has always been difficult, in marked contrast to the ease with which a spica can be applied to the lower part of the body, using the Hawley table with its sacral rest and perineal post. The writer has often in the past, when acting as an assistant, tried to hold the patient steady while the operator applied a shoulder spica. The most satisfactory way was to pass the hand down under the interscapular region, and support the weight of the body with it. Very soon this weight became almost intolerable, and usually before the spica was applied there would be some shifting of position, giving an unsatisfactory result. This was partly obviated by putting on the lower part of the spica before the patient was anaesthetized, thus shortening the operation; but even this arrangement left much to be desired.

These difficulties suggested the apparatus shown in the illustrations. It was made for the writer by Mr. F. P. Jones, the Engineer of St. Boniface General Hospital.

The essential part is the arm *D*. This takes the place of the assistant's hand and forearm as described above. It corresponds to the sacral rest of the Hawley table. It was made from a part of an automobile spring, and shaped so as to conform to the curve of the thoracic and cervical spine. A smaller one with a suitable curve should be at hand for children. It is made to fit accurately the upper end of the shaft *B*, and can be easily lifted off the shaft at the completion of the operation. It can then be removed from between the patient and the spica without difficulty.

The shaft *B* was made from the rear axle of a Ford car. It fits into the stand *C*, and can be raised or lowered by adjusting the set screw. The importance of this is shown in Figure 2. The stand *C* is from a side table in use in the operating room. The head-piece *A* was an afterthought, but it has proved to be quite useful under some circumstances. It is fastened to the shaft *B* with a locking screw so that it can be let down out of the way if desired. Each of the side pieces is arranged so that one or both of them can be turned down out of the way if it is desired to turn the patient's head to one side,—*e.g.* should vomiting occur.

Figure 2 shows the apparatus in use. The assistant holds the affected arm in the desired position, while the nurse holds the other arm out of the way. The patient's pelvis and lower limbs are resting on the Hawley table on which the operation was done.

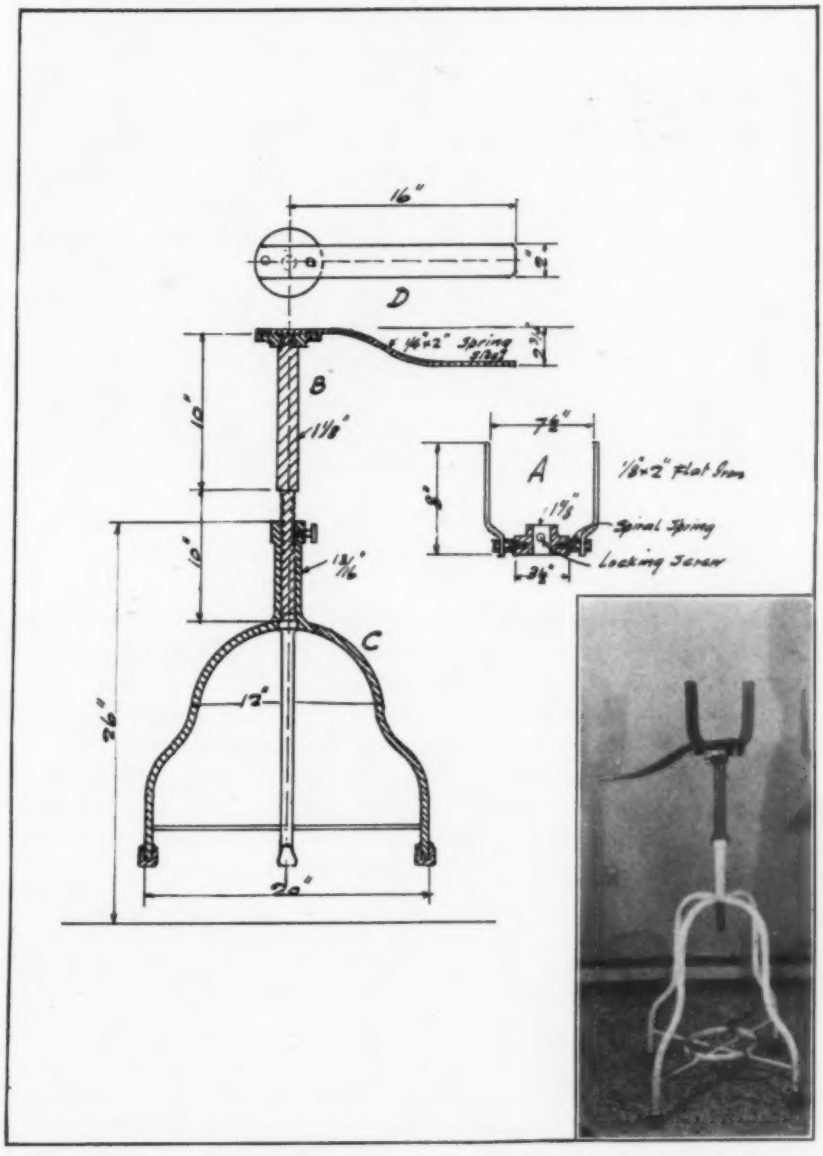

FIG. 1

Details of apparatus (see text). Insert is a photograph of apparatus.

FIG. 2
The apparatus in use

The apparatus has been in use for several months in St. Boniface Hospital, and has proved a great convenience. We have come to regard it as indispensable after the operation of arthrodesis of the shoulder. It has also been used very satisfactorily in one case of fracture-dislocation of the cervical spine, and in one case of Pott's disease of the upper thoracic vertebrae, in each of which it was necessary to apply a plaster jacket with head-piece, while traction was being made on the head.

THE SLIPPING FEMORAL EPIPHYSIS

BY THEODORE A. WILLIS, M.D., CLEVELAND, OHIO

There is no surer way of stimulating literary effort relative to a certain condition than the publication of an essay describing it as of rare occurrence. A recent reference to the "barrenness of American literature" in respect to slipping of the capital epiphysis of the femur has been followed by a fecundity suggesting that the very frequency of the condition may have militated against its discussion.

Among the more comprehensive of the recent publications are those of Key[3] who advances a plausible theory of mechanical etiology and cites 102 references to the subject, many of which are of American origin; Bernstein and Arens[2] who are convinced that it is of endocrine origin and submit the term "epiphyseolysis" as a suitable name for it; and Badgely who discusses the treatment of twenty-seven cases[1].

The greatest divergence of opinion expressed by both European and American writers on the subject is in regard to its etiology. This has become a triangular debate between the proponents of disease—particularly endocrine disturbance,—static forces, and trauma as etiologic factors. The arguments on each side are convincing but until further proof is offered, none is conclusive. It is probable that any one of the three may predominate in an individual case, or be the sole factor concerned.

The writer, dodging for the moment the discussion of etiology with the statement that the majority of his cases have occurred following definite injury in overweight adolescents of infantile type, wishes to add fifteen to the number of recorded cases and to present three in detail to illustrate his idea of proper treatment of the lesion in its different stages.

CASE 10. A. S. Colored female, aged twelve. First seen at Charity Hospital dispensary on December 16, 1926, complaining of pain in her left knee. Onset without definite injury about six months previously, with pain and aching after sitting for some time, and stiffness when first moving about. The symptoms had become more pronounced recently.

The patient was sixty-one inches tall and weighed 148 pounds. This is forty-five per cent. overweight according to height-weight charts at hand. She walked with a slight limp on the left; and was moderately knock-kneed. The left hip was adducted, but there was no actual shortening. Rotation and abduction were limited, flexion and extension normal. The girl showed no secondary sex changes. X-ray (Fig. 1) showed absorption on the shaft side of the epiphyseal line with very slight depression of the femoral head on the neck.

The patient was measured for a weight-bearing abduction hip brace and a plaster hip spica was applied. On February 24, 1927, the plaster was removed and the brace applied. Examination at that time showed no change from the preceding. She did not report again until hunted up by the Social Service on April 23. She then walked well with the brace and motion was as noted previously. An x-ray was ordered, but the

patient disappeared and was not found again until October 20, when she came in complaining of increasing pain. Motion was limited in all directions and there was some tenderness about the hip joint. She was still wearing the brace, but it was no longer bearing weight on the ring, due to length of the limb. Again she failed to report for x-ray and it was not until November 26 that another film was obtained (Fig. 2). This showed displacement of the femoral head downward around the neck, with fusion of the epiphyseal line, marked thickening of the neck, and a coxa vara of ninety degrees. On account of the marked external rotation and loss of abduction an osteotomy was advised. This was done by Dr. C. G. Barber on January 4, 1928 (Fig. 3). The plaster spica was renewed on March 29 and again on May 1. At this time the hip was in moderate abduction and the angle of the neck was restored, but there was but little mobility of the joint. The plaster was followed by the weight-bearing brace, properly adjusted, and mobility increased. X-ray in September showed fair union with moderate abduction. There was flexion contracture limiting extension at 135 degrees. Rotation and lateral mobility were still markedly limited. The patient then weighed 204 pounds and paid no attention whatever to diet restriction (Fig. 4).

When seen in March 1929, the girl walked without apparatus and was free from pain. There was considerable limp, due to flexion, and rotation and lateral motion were still deficient. This deformity is probably permanent.

Case 11. J. W. White male, aged thirteen. This boy was first seen at St. Luke's Hospital on January 12, 1928. His parents stated that a year previously he had fallen and bruised his right hip. He made a good recovery, but a few months later began to limp on that side. Nine months after the injury, while playing basket-ball, he developed a sudden severe pain in the hip. This did not respond to medical treatment and was markedly aggravated by osteopathy and bone-setting manipulations. When seen three months after the second injury, he was completely disabled.

Fig. 1

Case 10. X-ray six months after onset of symptoms. Left hip shows widening of the epiphyseal line, absorption on the shaft side of the line, and definite depression of the head.

The patient was an overweight boy of the infantile type. He walked with difficulty with a marked limp on the right. The right hip was adducted and rotated outward. Rotation and abduction were lost. Extension was complete, flexion limited at 135 degrees. There was tenderness over the hip joint, and one inch shortening. X-ray (Fig. 5) at this time showed upward displacement of the neck of the femur on the head which had slipped downward around the lower border of the neck.

Under anaesthesia the hip was manipulated, completely abducted, and a plaster spica applied. X-ray on the following day showed complete abduction with the trochanter butting againt the acetabulum, but no change in the relation of the fragment (Fig. 6). On January 17 an open reduction was done and the head easily replaced on the neck. A plaster spica was applied in moderate abduction and internal rotation. X-ray then showed satisfactory position of the fragments (Fig. 7).

On March 27 a new cast was applied with less abduction. This was removed on May 3 and active function was started. When last seen, December 22, 1928, flexion

FIG. 2

Case 10. X-ray eleven months after Fig. 1. The head of the left femur has been displaced and has united in malposition. Note fusion of the epiphyseal line, shortening and torsion of the neck, and marked coxa vara. This is a typical picture of an untreated or inefficiently treated lesion.

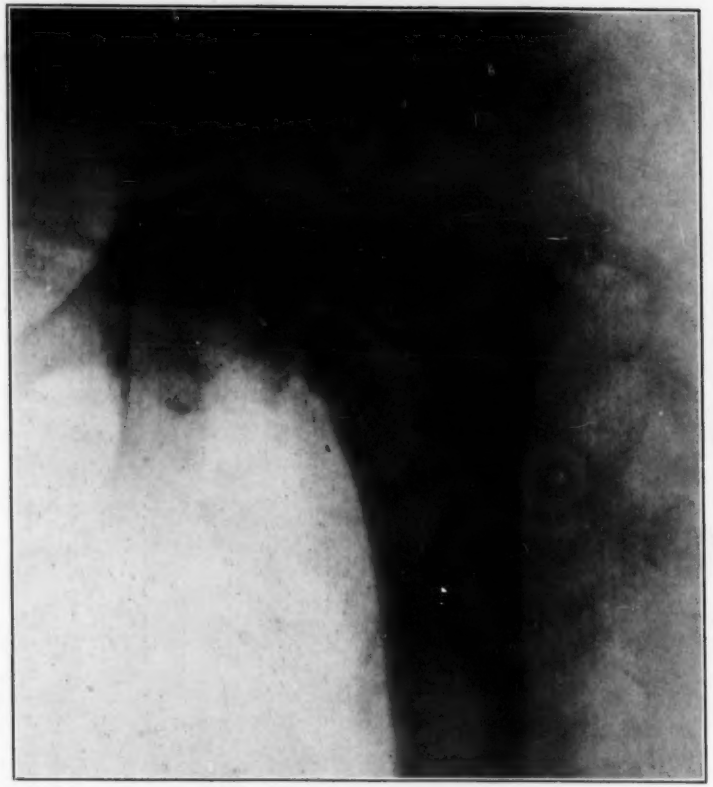

FIG. 3

Case 10. Immediately after osteotomy of the femoral neck to correct the coxa vara shown in Fig. 2.

FIG. 4

Case 10. Final result showing union after osteotomy, with restoration of the angle of the neck. Note shortening of neck and deformity of the head and acetabulum.

FIG. 5

Case 11. X-ray one year after the first injury and three months after the second. Note displaced epiphysis of right femur, narrowing of the joint line and position of lower border of the head.

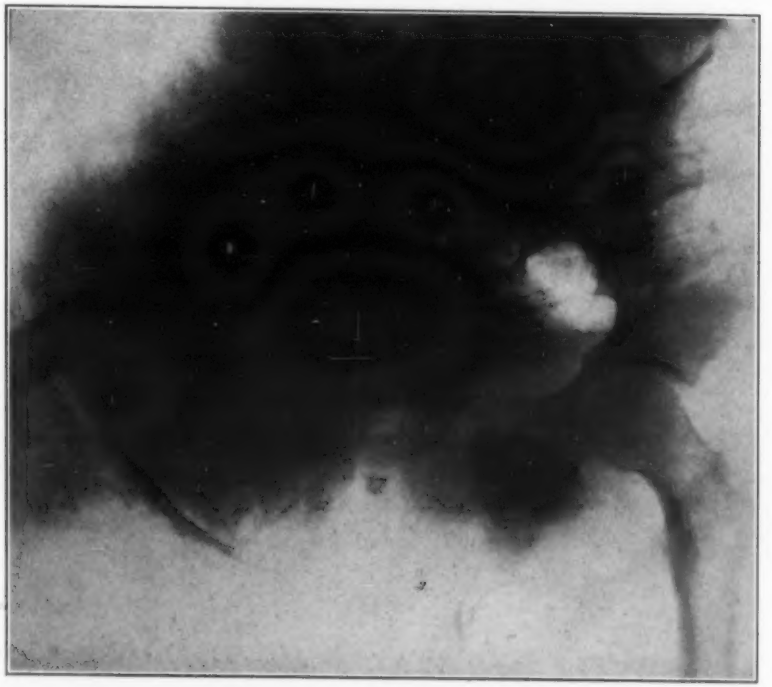

FIG. 6

Case 11. X-ray after manipulation and application of plaster. The abduction is complete but the position of the fragments has not been improved.

FIG. 7

Case 11. X-ray after open reduction. The fragments are replaced and the angle of the neck is restored.

FIG. 8

Case 11. X-ray eleven months after operation. Note normal angle and alignment, but some flattening of head and acetabulum. The epiphyseal line is fused.

FIG. 9

Case 12. X-ray one year after injury and six months after onset of symptoms. Note slight rarefaction along the shaft side of the epiphyseal line of left femur. Depression of the head is very slight if present at all.

was free to eighty degrees, extension to 180; abduction and rotation were moderately limited. There was no mensurable shortening. X-ray at this time (Fig. 8) showed fusion of the epiphyseal line with slight upward displacement of the head. Both acetabulum and femoral head were slightly flattened.

CASE 12. J. B. White female, aged eleven. Referred by Dr. Ray Thompson. The patient had fallen a year previously, hurting her left hip, but had made a complete recovery and had no pain until five or six months later when her left knee and hip tired easily and ached after use. The symptoms became progressively worse and she was seen by Dr. Thompson who took an x-ray of the hip early in February 1928 (Fig. 9). This showed absorption along the shaft side of the epiphyseal line and slight depression of the head on the neck. On February 9 the patient fell and was completely disabled. The writer saw her in consultation at that time and another x-ray showed complete separation of the femoral heod (Fig. 10).

The patient was an overweight adolescent girl showing no secondary sex changes. She lay in bed with her left hip adducted and rotated outward. There was three-quarters of an inch shortening, muscle spasm, and pain on motion in all directions. The hip joint was tender to pressure.

Under ether anaesthesia the hip was manipulated and a plaster spica applied in complete abduction, slight flexion, and internal rotation. X-ray taken through the plaster (Fig. 11) showed satisfactory reduction of the displacement. Two months later the plaster was removed from the knee down and active use of the leg encouraged, without weight-bearing. A month later the rest of the plaster was removed and active motion of the hip started. Four weeks after this, while walking with crutches, the patient fell, injuring the left knee but not the hip. At this time there was active motion of the hip from 120 to 180 degrees, with slight rotation and lateral mobility. Function

FIG. 10

Case 12. X-ray a few days after Fig. 9. Note complete separation of the epiphysis with marked displacement.

FIG. 11

Case 12. X-ray after manipulation and application of cast. Note restoration of the angle of the neck by reduction of displacement.

FIG. 12

Case 12. X-ray one year after reduction. Note practically normal angle of the femoral neck but considerable deformity of the head and acetabulum, indicating some limitation of mobility. The epiphyseal line is fused.

was gradually increased and a year after the injury motion was free and painless from 180 to ninety degrees. Very little rotation or lateral motion had developed. X-ray (Fig. 12) showed good position of the femoral head, but considerable deformity of the acetabulum and head. The epiphyseal line was fused. There was one-half inch shortening and the patient walked with a limp.

TABLE

No.	*Name*	*Age*	*Sex*	*Color*	*Injury*	*Duration*	*Side*	*Treatment*	*Result*
1.	E. J.	12	F.	W.	No	6 weeks	L.	Plaster	Good
2.	V. S.*	14	F.	W.	Yes	1 year	L.	Plaster	Good
3.	R. S.	43	M.	W.	Yes	30 years	R.	Unknown	Fair
4.	C. W.	14	F.	W.	Yes	Unknown	R.	Operation	Good
5.	R. S.	16	M.	W.	No	6 months	L.	Brace	Fair
6.	F. E.	14	M.	W.	No	5 months	L.	Brace	Fair
7.	B. W.	?	F.	W.	Two	11 months	R.	Operation	Good
8.	B. K.	?	F.	W.	Yes	2 months	R.	Plaster	Good
9.	R. C.	15	M.	W.	Two	6 months	R.	Plaster	Good
10.	A. S.	12	F.	C.	No	6 months	L.	Brace and operation	Poor
11	J. W.	13	M.	W.	Two	6 months	R.	Operation	Good
12.	J. B.	11	F.	W.	Two	6 months	L.	Plaster	Good
13.	L. W.	16	M.	C.	Yes	Few weeks	R.	Plaster	Good
14.	J. G.	14	M.	W.	Yes	4 months	L.	Refused	
15.	L. W.	13	F.	C.	Yes	5 months	R.	Refused	

*Father of V. S. remembered hip injury in his youth. Had been lame since. X-ray showed typical coxa vara.

Treatment: Plaster indicates plaster immobilization with or without manipulation.
Brace indicates weight-bearing hip splint.
Operation indicates open operation.

The following conclusions have been drawn from observation of this small series of patients:

1. No matter how treated, the lesion causes a premature fusion of the epiphysis and consequent effect upon growth.

2. There is deformity of the femoral head and acetabulum inversely proportionate to the efficiency of treatment.

3. There is restriction of function in proportion to the deformity.

4. Untreated or inefficiently treated cases show a typical deformity of thickened neck, coxa vara, limitation of lateral mobility and rotation, flattening of the acetabulum and femoral head, torsion and shortening of the femoral neck.

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PROGRESSIVE MUSCULAR DYSTROPHY

Report of a Case

BY MIGUEL STEINBERG, PH.D., M.D., NEW YORK

The case here described is interesting on account of the combination of the symptoms that it presents.

CASE REPORT

Patient A. H., a twenty-year-old, single American of Hungarian descent, came to the evening clinics of the Hospital for Joint Diseases (Chief, Dr. I. Tunick) mainly complaining of diminished power in both arms, which prevents his doing regulation manual work.

His family history is of no significance. At the age of eight he had an automobile accident, which did not result in any serious consequences; otherwise his personal and previous history are irrelevant.

Present Illness: About a year ago his mother noticed that his shoulder blades were

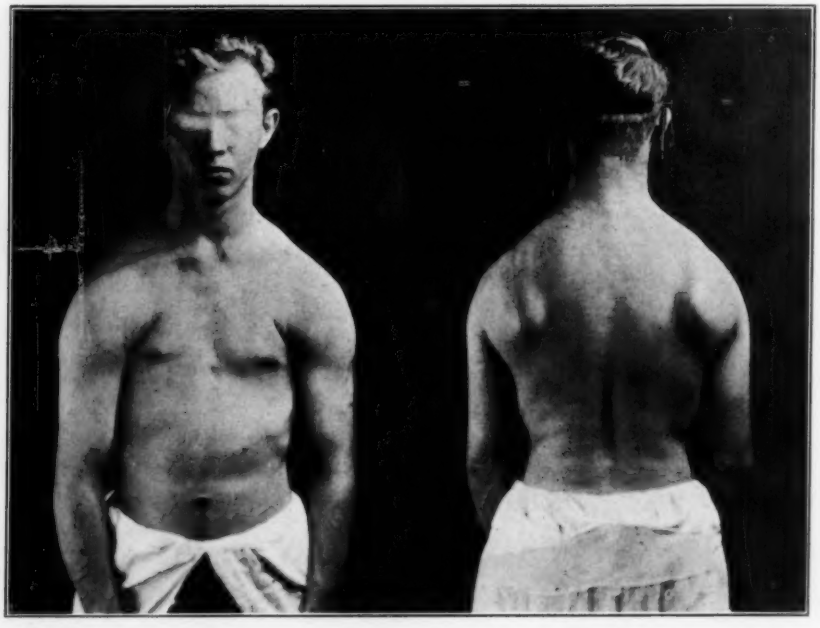

Fig. 1

Front View. Myopathic face of mild degree. Stooping attitude in station. Sloping of the lateral outlines of the neck. Absence of the sternocostal and the abdominal parts of the right pectoral muscle. Note the elevation of the nipple on the right side.

Fig. 2

Posterior View. The shoulder blades are moderately elevated and the lower angles are slightly raised from the thorax. This phenomenon is more marked on the right side. The inner borders of the scapulae have an oblique position. A very mild lordosis is noticeable.

protruding. He himself became aware of a gradually progressive weakness in his arms and an inability to raise them above the horizontal plane.

On *Physical Examination* the following deviation from the normal is found. The patient appears frail and has a stooping attitude in gait and station. There is a sloping on both sides of the lateral outlines of the neck. There is a slight weakness and atrophy of the facial muscles, especially brought out on whistling and pouching of the lips. The nasolabial folds are flattened. The expression of the face is of a mild myopathic character, yet there is no difficulty in chewing, swallowing, and speaking. Tremor of the eyelids is present. His palate is highly arched. The right pectoralis major is absent with the exception of the clavicular portion. The right part of the chest is more flattened than the left. The nipple on the right side is elevated. On deep inspiration the ribs on the right side are slightly protruded. The pectoralis minor is intact. There is a bilateral combination of atrophy with an actual hypertrophy and pseudohypertrophy of the shoulder muscles, more pronounced on the right side. The adduction of the arms is unimpaired.

When at rest both shoulder blades are moderately elevated, the upper borders are visible from the front and the inner borders accept an oblique position with a slight protrusion of the lower angle of the bones. This phenomenon is more marked on the right side.

In abduction of the arms to the horizontal line at the side, the vertebral borders of the shoulder blades approach the spinal column and project from the thorax, the right noticeably much more so.

The patient cannot raise his right arm above the horizontal line. When an attempt is made to go above the horizontal plane he brings into action the auxiliary axio-appendicular muscles, but the result is a dismal failure. The left arm can be raised vertically

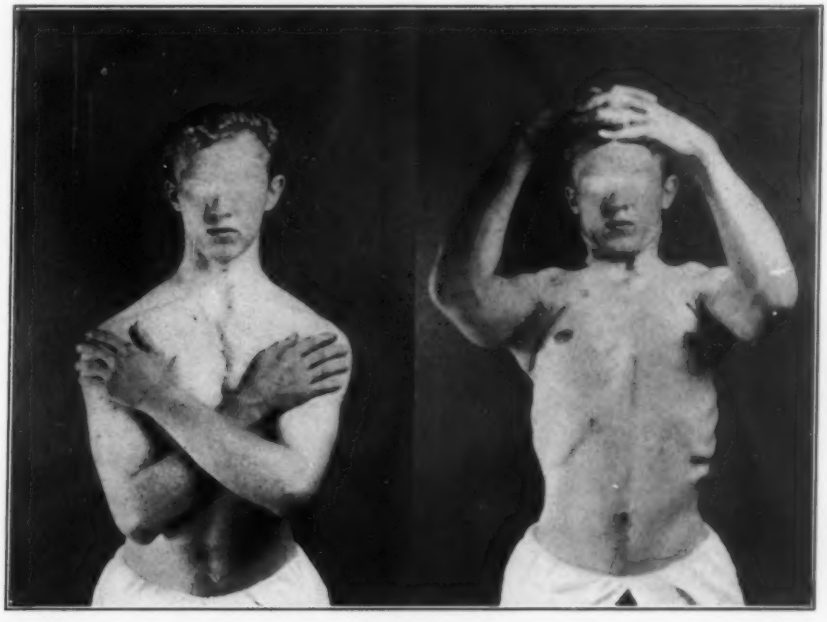

FIG. 3 FIG. 4

Front View. These pictures show no functional disability in spite of the almost total absence of the right pectoral muscle. The patient can cross his arms as well as extend them in front of him and press them together tightly without any difficulty.

FIG. 5

Posterior View. Abductions of the arms to the horizontal line at the side. The vertebral borders of the shoulder blades approach the spinal column and project from the thorax, the right noticeably much more so.

upward only partially, and that with extreme effort reenforced by the aid of the auxiliary muscles.

When the upper extremities are extended horizontally in front of the body, the shoulder blades are protruding extremely, giving the picture of being "winged". This is more evident on the right side. The slight elevation of the shoulder blades is a myodynamic phenomenon.

His handgrip is fairly vigorous. His ability to lift and raise things is much below the normal. There is a very mild lordosis noticeable. There is no difficulty in sitting up and getting up from a reclining position. Fibrillations of the individual muscle fibers or muscle bundles are absent. The distal musculature does not show any dystrophic phenomena.

The deep and superficial reflexes are unaffected. The reaction of degeneration test is negative. There is no evidence of objective sensory disturbances. The mentality of the patient is perfectly normal. X-ray pictures do not show any pathological changes. Laboratory tests are negative.

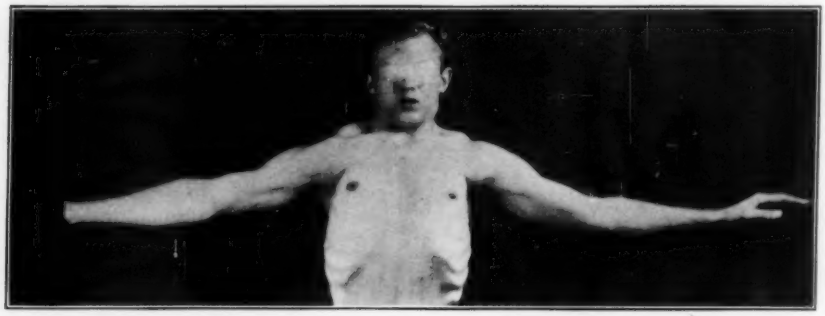

FIG. 6

Front View. Showing hypertrophy and pseudohypertrophy of the upper part of the trapezii and the deltoids, more prominent on the right side. Note the expression of strain on the face of the patient.

FIG. 7

Front View. In an attempt to raise the upper arms above the horizontal border the patient brings into action the auxiliary axio-appendicular muscles.

FIG. 8

Posterior View. This shows not only the phenomena previously mentioned, but also the projection of the shoulder blades with its inferior angles and vertebral borders outward. This is more marked on the right side. Note the bending of the thorax backward.

COMMENT AND LITERATURE

This case is characterized by the insidious onset and the gradual progressing course of the disease. There is a bilateral atrophy characterized through the diminution of the volume, tone, and consistency of the muscles and combined with hypertrophy and pseudohypertrophy of the axio-appendicular muscles of the upper extremities. An impairment of the action of the engaged muscle groups, more marked on the right side, is present. The almost total absence of the right-sided pectoralis major muscle has no physiological effect. There is no neural distribution of this myopathic affection. The history in our case was not able to elicit any data as to the heredofamilial character of the disease. There are no signs of any endocrinal disturbances. We are dealing here with a facio-scapulo-humeral type of progressive muscular dystrophy.

Oppenheim saw just as many sporadic as familial cases of progressive muscular dystrophy. In one case he was able to demonstrate also a dystrophy involving the muscles of the tongue, the palate, and the larynx. This approaches the bulbar paralytic type of progressive muscular dystrophy described first according to Oppenheim, by J. Hoffman. Marie,

Oppenheim, Kollarits, and Wendenberg saw also primary muscular dystrophy of the jaw muscles (quoted by Oppenheim). Muscular dystrophy of the extrinsic ocular muscles was seen in rare instances by Gowers, Lombroso, Oppenheim, Marie, Bäg, and Jendrassik (quoted by Oppenheim).

Congenital malformations of the axio-appendicular skeleton are occasionally concomitant factors in progressive muscular dystrophy (Oppenheim). Friedreich, Schultze, Lloyd, Clarke, Spiller, Noica, and Schlippe observed atrophy of the bone, while Marie and Crouzon reported a spontaneous fracture in connection with the progressive muscular dystrophy (quoted by Oppenheim). Oppenheim observed occasionally as sequelae contractures of the biceps, flexors of the knee, and the calf muscles and also the pes-equinus position. He believes that myosclerotic processes are responsible for the contractures. He also reports a case of progressive muscular dystrophy with tabetic complication and mentions also a case of Cassirer, which showed a combination with poliomyelitis.

McCrudden in his studies of blood chemistry in cases of progressive muscular dystrophy comes to the following conclusions: "The facts indicate that the myasthenia of progressive muscular dystrophy is due to hypoglycemia; that the hypoglycemia and fatty infiltrations are due to impaired glycogenesis, the carbohydrate of the food being probably changed largely to fat instead of glycogen; and that this impaired glycogenesis is the result of adrenal or other endocrine disease".

Janney, Goodhart, and Isaacson try to establish a causative connection between the endocrine system and the progressive muscular dystrophy. In their studies of a number of patients afflicted with the progressive muscular dystrophy, they found changes indicative of general endocrinopathology, as dryness and abnormal pigmentation of the skin, acromegalic features, brittleness of the hair, hypertrichosis, trophic changes in the nails, unusual distribution of subcutaneous fat, regressive osseous changes, marked retardation of growth, hypoglycemia, delayed glucose utilization, and changes in the urinary contents of creatin and creatinin.

Villacián describes two cases of progressive muscular dystrophy with simultaneous involvement of the upper and the lower extremities in combination with syphilis. Painful cramps and stiffness of the muscles were present.

Cadwalader and Corson-White report several cases of hereditary syphilis with progressive muscular dystrophy.

Friedman describes a case, which represents a combination of primary myopathy of the Erb type with progressive muscular atrophy of the Werdnig-Hoffman type.

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AN ADJUSTABLE CONVEX FRAME*

BY MAURICE H. HERZMARK, M.D., NEW YORK

House Surgeon, The Hospital for the Ruptured and Crippled

For the purpose of obviating the disadvantages of the convex stretcher frame, the writer has modified it so as to make it adjustable.

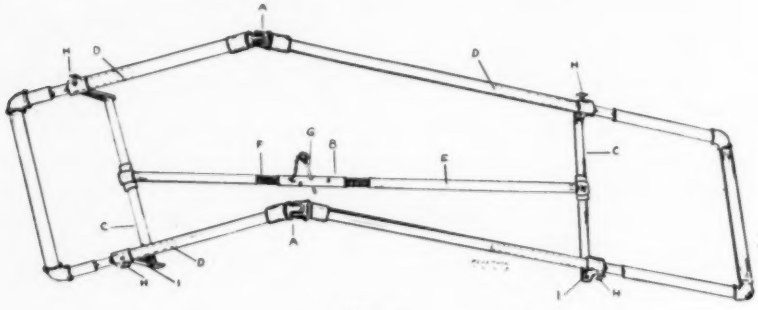

FIG. 1

Sketch of adjustable frame

A — Hinges.
B — Sleeve of turn-buckle.
C — Cross-bars.
D — Telescoping side bars.
E — Turn-buckle rod.
F — Threads upon which sleeve screws.
G — Peg to turn sleeve.
H — Set screws.
I — Arm which holds cross-bars.

This adjustable frame (Fig. 1) consists essentially of end bars, hinged side bars, and a turn-buckle mechanism attached to cross-bars. For the purpose of regulating the location of the convexity, the side bars have been made to telescope at the head and foot ends (Fig. 1-*D*). The hinges of the side bars (Fig. 2) are so designed that they do not interfere with the coverings of the frame and operate smoothly and easily. They do not extend beyond the diameter of the bars and thus can cause no discomfort to the patient. The cross-bars (Fig. 1-*C*) to which the turn-buckle attaches, are placed at a lower level than the frame (Fig. 4) to increase the leverage of the adjusting mechanism, and provide sufficient clearance when the frame is made concave. The telescoping portion of the side bars can easily be pulled in or out of their counterparts (Fig. 1-*D*), and are held in place at any desired point by set screws (Fig. 1-*H* or Fig. 4-*C*). The hooks which hold the frame to the bed (Fig. 3-*A*, *B*, *C*) are free to swing back and forth as adjustments are made, and yet provide a very secure attachment.

*From the Service of Dr. Royal Whitman.

FIG. 2

Hinge which can be screwed into tubular side bars.

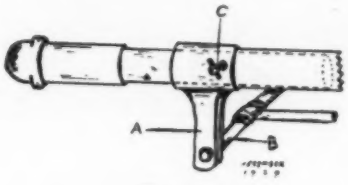

FIG. 4

Sketch of right-angle arms showing how cross-bars are placed at lower level than plane of frame.

A — Right-angle arm.
B — Cross-bar.
C — Set screw.

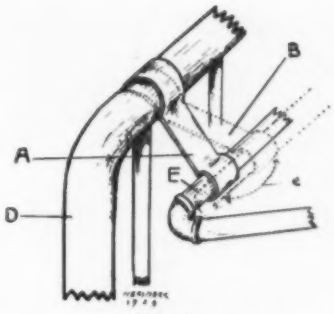

FIG. 3

Detail sketch of hook which holds frame to bed.

A — Hook.
B — Position of hook shown in dotted lines when frame is in convexity.
C — Arc through which hook travels when frame is adjusted.
D — Frame of bed.
E — End bar of adjustable frame.

To operate the adjustable frame, the sleeve of the turn-buckle (Fig. 1-*B*) is rotated by means of the peg (Fig. 1-*G*). To increase the convexity, the sleeve is turned clockwise; to decrease the convexity the sleeve is turned counter-clockwise. During the process of adjustment, there is no interference with the coverings, and there is no discomfort to the patient.

This adjustable frame is now in use on the Service of Dr. Royal Whitman at The Hospital for the Ruptured and Crippled. The advantages of this frame are:

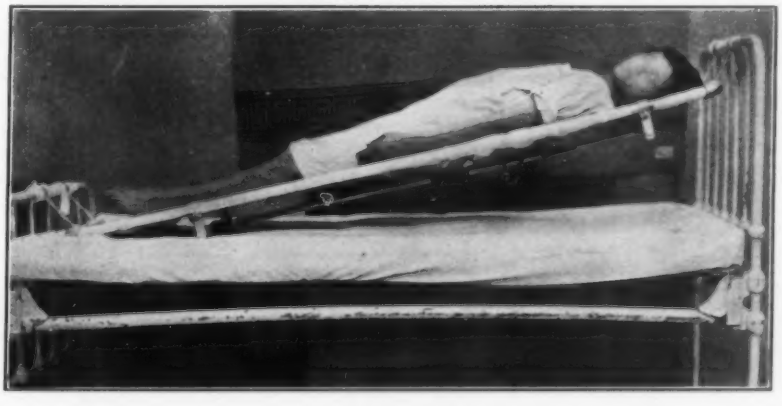

FIG. 5

The adjustable frame in slight concavity. Note the turn-buckle mechanism beneath the frame.

FIG. 6

The frame has been adjusted to convexity without removing or disturbing the patient.

1. Any increase or decrease of convexity may be obtained without removing the patient from the frame.

2. The position of the convexity may be placed at any desired level without disturbing the patient.

3. Increase in convexity may be made as gradual as necessary, without interrupting treatment.

4. All adjustments may be controlled by the surgeon and take only a few minutes.

5. If it is desired to turn the patient face downward for exercises or feeding, the frame may be made concave, and the hyperextension of the spine maintained in this position.

FIG. 7

The frame has been adjusted to an angle of about 145 degrees. The sharp angulation is ameliorated by the canvas covering.

6. The reenforcing cross-bars, to which the adjusting mechanism is attached, prevent sagging of the canvas covering and eliminate the constant tightening necessary with the ordinary frame.

7. Since there is no bending of bars, the frame is practically indestructible.

8. The frame requires no special type of bed and may be quickly and easily attached.

9. Any good mechanic can make this frame at reasonable cost.

This adjustable frame has a worthy place as an aid in the therapeusis of so difficult a group as that of diseases and deformities of the spine.

EARLY TREATMENT OF CONGENITAL DISLOCATION OF THE HIP*

BY PROF. VITTORIO PUTTI, BOLOGNA, ITALY

Istituto Ortopedico Rizzoli

The technique now in use for the closed reduction of congenital dislocations of the hip has attained such a degree of perfection that I believe very little can be done to improve it; and little is to be hoped from possible modifications. Those who are dissatisfied with closed reduction (and amongst them is Dr. Allison of Boston) propose to apply on a much wider scale reduction by open operation. I do not believe that this represents the best solution of the problem. To my thinking, the road to be followed is a different one, that is the *lowering of that age limit*, which is still commonly considered the *youngest suitable* for beginning treatment.

The idea that treatment ought to be begun early is agreed to by everyone. The age which at present is considered most suitable is two years, that is the age at which the deformity becomes noticeable on account of the characteristic limp.

I contend that there is no reason, either theoretical or practical, which forbids our commencing treatment before that age.

It is a fundamental principle of orthopaedics that congenital deformities should be treated from the moment of birth. Why on earth should not this principle, which, for example, is so rigorously applied in the treatment of club-foot and which, with more laxity, is adopted in the treatment of wry-neck, cleft palate, and scoliosis, why should not this hold good also for that of congenital dislocation of the hip? The actual reasons against it are the following:

1. Because it is very difficult, and often impossible, to recognize the dislocation until the child has begun to walk.

2. Because it is said that at one or two years of age the condition of the joint is mechanically more favorable for reduction.

3. Because it is technically difficult to keep immobilized for many months an infant who has not yet gained control of his bodily functions.

Let us consider what validity there is in these objections to early treatment.

It is undeniable that it is not easy to discover the dislocation before the child has begun to walk. Yet there are a number of signs which may make us suspect it, and the suspicion can easily be confirmed by x-rays. In Italy there are regions where these dislocations are so common, and where

*Paper read at meeting of the British Orthopaedic Association and American Orthopaedic Association, London, July 4, 1929.

what one may call the "orthopaedic education" of the doctors and of the people themselves is so advanced, that the mothers spontaneously, or on the advice of the family doctor, bring up children a few months old in order to have their fear of the deformity cleared up. The loving eye of a mother does not miss even slight evidence of asymmetry or abnormality; and the doctor, who knows that the dislocation is frequently hereditary or familial, will not fail to warn the parents, who have dislocations amongst their forebears, or have it themselves, or whose first child was treated for dislocation. In this manner propaganda and orthopaedic instruction have already borne excellent fruit in Italy.

Furthermore, is it really very difficult to diagnose the dislocation before one year? If a mother often succeeds in doing it, why should not a doctor always succeed? If you ask the mother what are her reasons for suspecting the deformity, usually she will not answer precisely; she merely noticed some little asymmetry, something unusual in the shape, the outline, or the attitude of one limb. One limb seems to her shorter than the other; one of the feet turns outward; in separating the lower limbs she saw, or felt, that one went less easily than the other; she observed that one limb was held in a certain degree of flexion; or that, if she tried to correct this flexion, the child cried. It is just such small signs that make one suspect a dislocation, and which should induce one to have an x-ray examination.

As for the second objection, that is, that the condition of the joint is not suitable for stabilization by reduction before two years, it has no justification, now that one can succeed in obtaining a cure, without exactly resorting to a manipulation of reduction.

Finally, there are the technical difficulties of treatment. But even this problem can be solved easily seeing that, as reduction is not necessary, there is no longer any need for rigorous immobilization, and one can dispense with plaster-of-Paris. In order to keep the legs widely separated for a long time, and to increase gradually the abduction, it suffices to use very simple apparatus, which can be applied and kept in position easily, even in children who are not clean in their habits. I will explain in a moment what these mechanical appliances are.

I think I have demonstrated how illogical are the objections which are brought forward against the earliest possible treatment of congenital dislocation. To this reasoning I cannot refrain from adding one more point, which seems to me of general importance.

It is well known that in favorable cases one may have autoreduction of the dislocation, that is spontaneous reduction. It is a rare but indisputable phenomenon. It has been reported even in recent publications by Diricks in France, Jungmann in Germany, and I have come across more than one case in my own practice. This phenomenon demonstrates that, under specially favorable conditions, treatment is not necessary, and such conditions will, in my opinion, be found in the majority of cases where the dislocation is encountered before the eighth month of life. At this age, a position of the limbs which compels the femoral head to exert pressure on

the acetabulum for several months is, as proved by facts, sufficient to direct the plastic forces in a manner favorable to the reconstruction of a normal joint.

In the first few months of life the separation is so slight that it suffices to put the limb in abduction at forty-five to fifty degrees, so that the head may lie opposite the acetabulum. It is enough to keep up this position for a few months in order to secure permanent reduction.

In accordance with the ideas to which I have already referred, I have evolved a method of treatment on the following lines:

1. To obtain reduction without any operation by forcing the limbs gradually into a position of maximum abduction with internal rotation;
2. To maintain the desired position by means of apparatus suited to the age of the patient.

This treatment cannot be expected to succeed except in children under twelve months of age, or very little over that. By this method I have cured up to date twenty-four cases.

The technique of the method is as follows: the aim is to keep a child of a few months old with the lower limbs abducted day and night for a long period. The problem can be solved simply by using a wedge-shaped cushion, rather firm, covered with water-proof cloth; and with this one can keep the limbs widely abducted (Fig. 1). This cushion is used for unilateral, as well as for bilateral dislocations. In order to increase the abduction gradually, the mother is instructed to widen the cushion periodically, which can easily be done by obvious means. The cushion is kept in place day and night, and is removed every time it is necessary to clean the child, also regularly twice a day for gentle, gradual manipulations into abduction and internal rotation, which the mother easily learns to carry out.

The small patients readily accustom themselves to the apparatus, which allows them to be carried about in their mother's arms and to enjoy an ordinary life. Every two months the patient is brought back to the hospital to be x-rayed. This opportunity is taken to see whether the treatment is going on satisfactorily, and whether the cushion requires alteration. After I was encouraged to make general use of this method I had constructed the apparatus shown in Figure 2 which, while still simple and economical, allows progressive abduction more easily than the cushion.

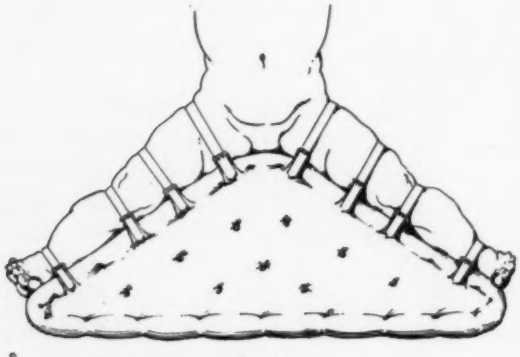

FIG. 1

The average duration of treatment is from eight to twelve months. It may be considered completed when clinical and x-ray examination show that reduction is perfect and that the recon-

stitution of the joint is well advanced.

Before I demonstrate the results obtained in the twenty-four cases, whose treatment is now finished, I must explain to you what I consider to be the characteristic x-ray signs of dislocation or subluxation of the hip in the first twelve months of life.

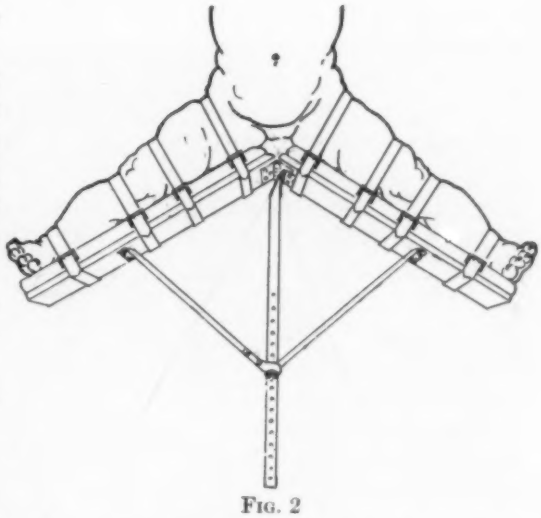

FIG. 2

These signs are primarily three:

1. The nucleus of the epiphysis is absent on the dislocated side, although present on the sound side, or if present, it is always smaller. This sign, naturally, is only applicable to unilateral dislocations, and only after the sixth month of life.

2. The top of the femur is some distance from the floor of the acetabulum, and is higher than normal.

3. The roof of the acetabulum is sloping. This is a most important sign, and it is most difficult to estimate, because the divergence from the normal is small.

With regard to the cases which I will now demonstrate, you must remember that the x-rays were used in confirmation of clinical signs which were always most definite. On the other hand, the objection may be raised that the supposed deformity would never have developed completely in all the cases; still one must agree that early treatment, even if it does not save the patient from a complete dislocation of the hip, yet preserves him from an actual disability, which I personally consider more serious than a dislocation, — that is from a subluxation.

Let us not forget that subluxations are rather more common than dislocations, and that, while the latter can be easily diagnosed and therefore are treated, the subluxation, on the contrary, does not become evident usually until late in life, when every chance of radical cure is gone.

I hope that I have by now proved that not only is it possible to treat congenital dislocation of the hip in children at a very early age, but that also this constitutes the *ideal treatment of the deformity*. The risks of anaesthesia are avoided. As no manipulation is necessary, trauma is avoided, which is the cause of osteochondritis. As rigorous immobilization is unnecessary, plaster-of-Paris can be avoided, and with it the atrophy of the muscles and rigidity of the joint. Last, but not least, the treatment is in every way considerably less expensive than the ordinary method. At

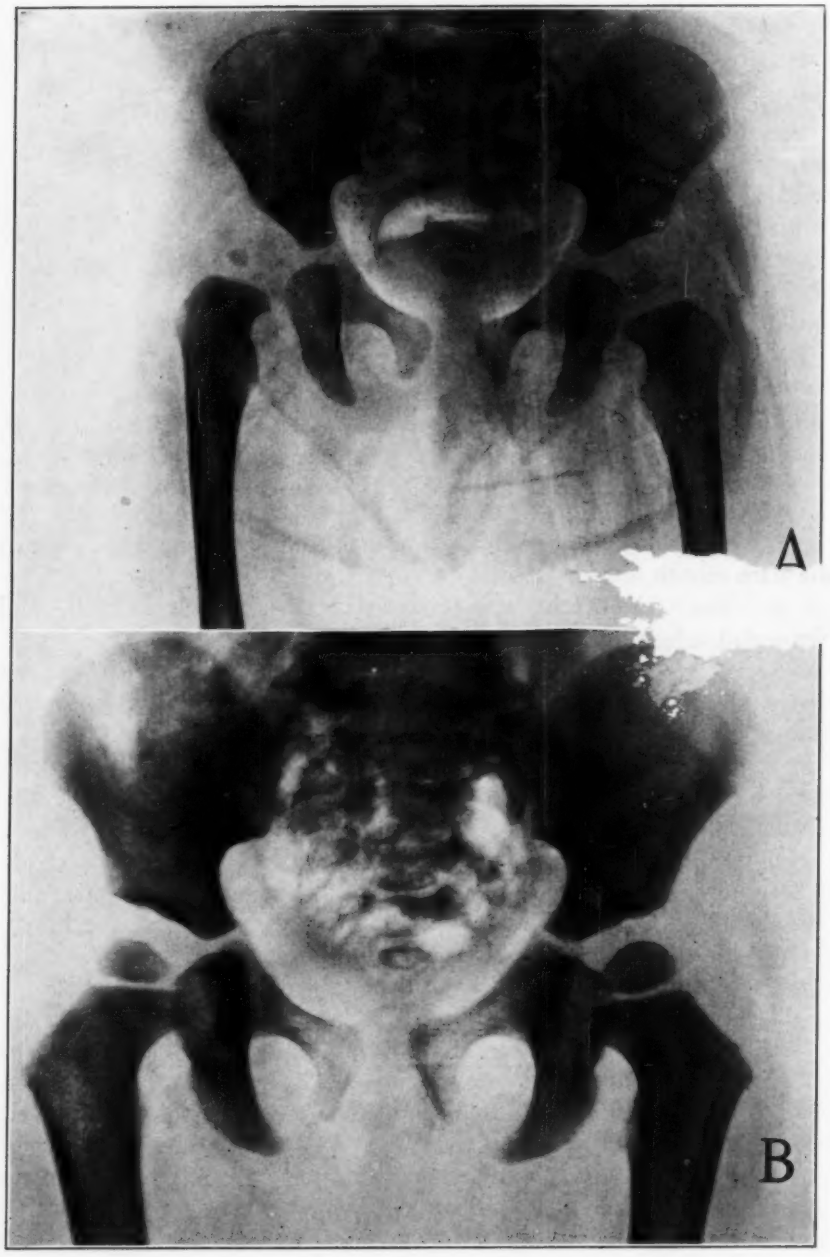

FIG. 3

A. At eight months.
B. After seventeen months' treatment.

FIG. 4

A. At three months.
B. Eight months later.

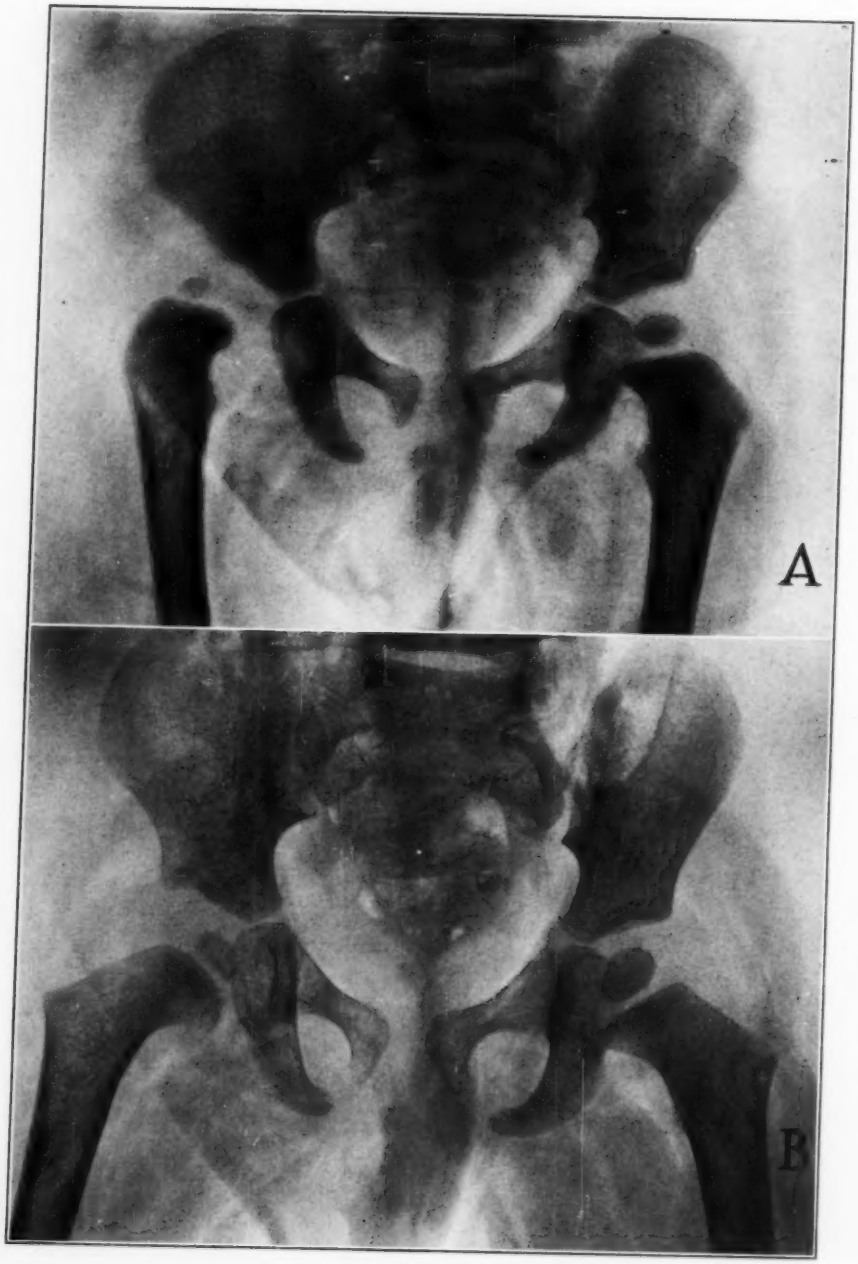

FIG. 5

A. At twelve months.
B. After seven months of treatment.

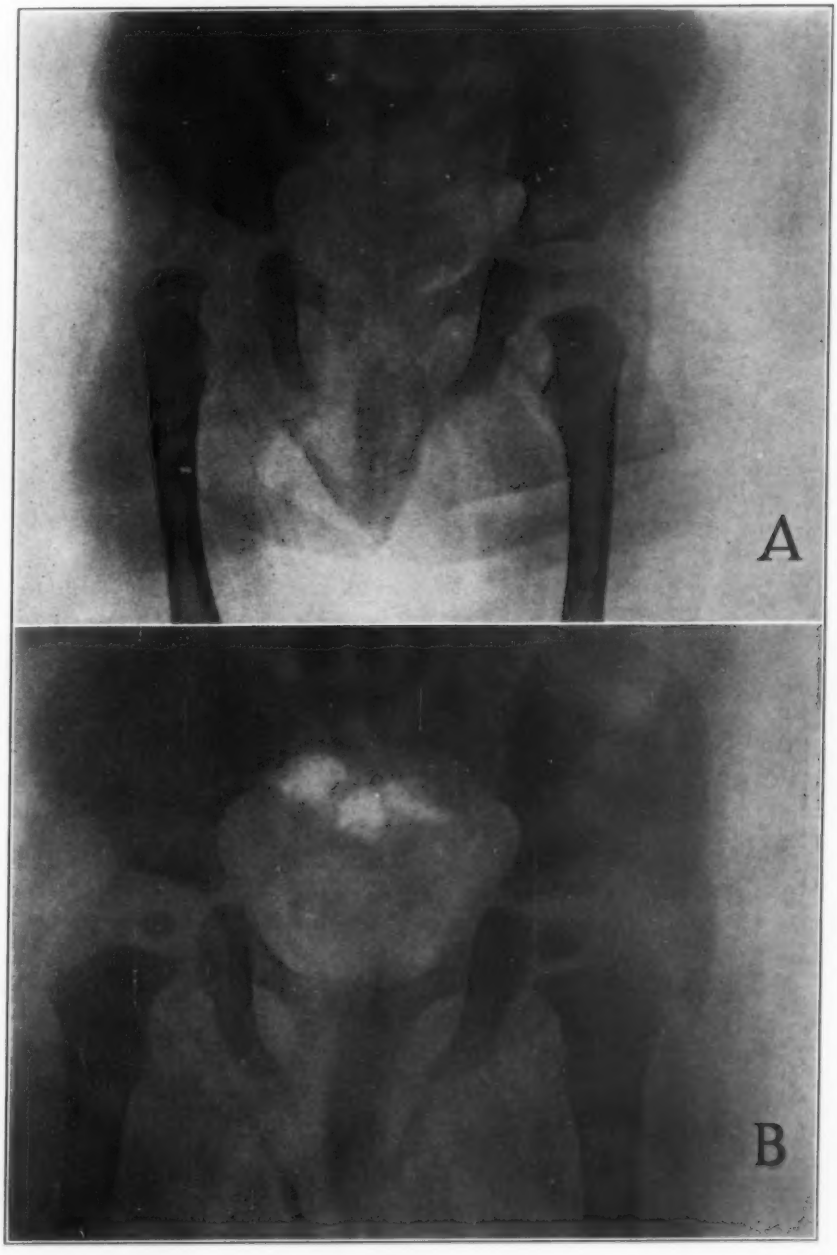

FIG. 6

A. At eleven months.
B. After ten months of treatment.

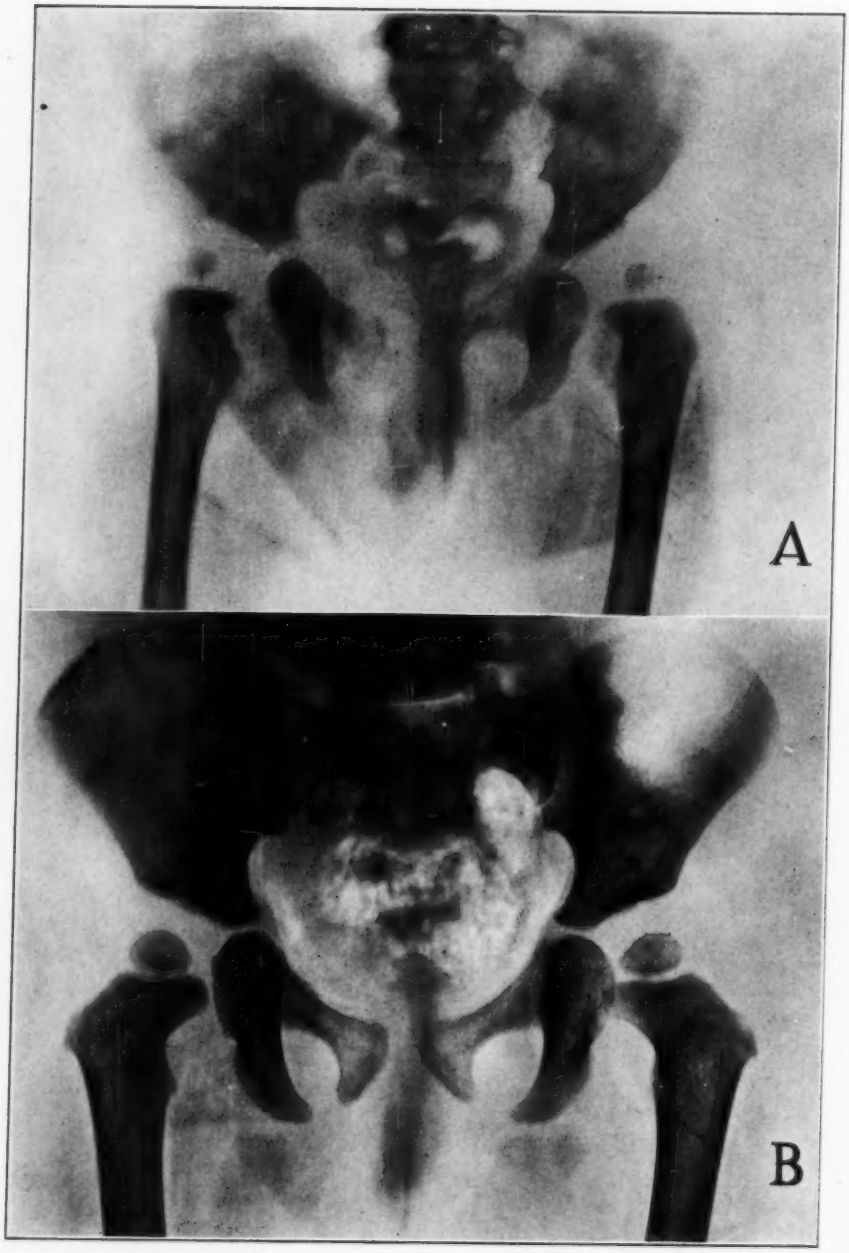

FIG. 7

A. At five months.
B. After twelve months' treatment.

FIG. 8

A. Twenty-four hours after birth.
B. After six months of treatment.

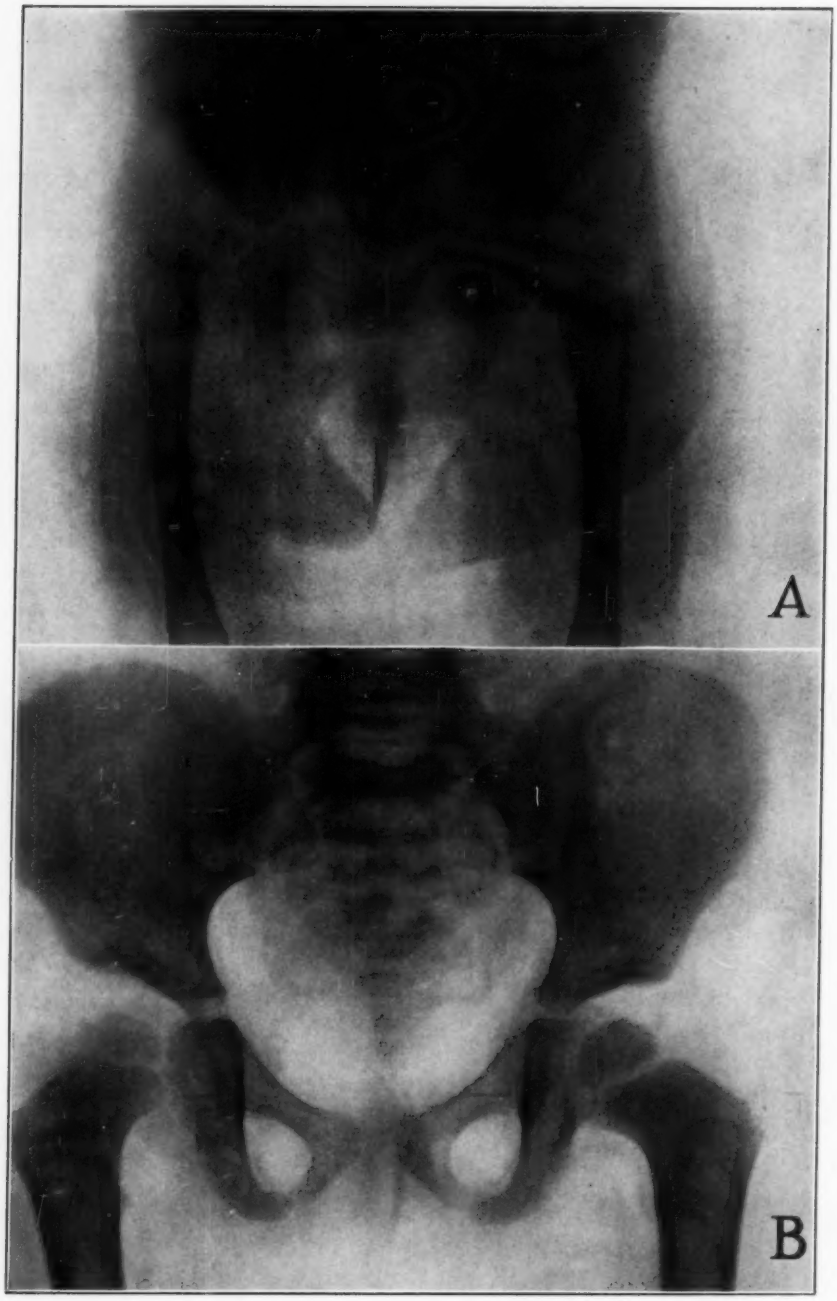

FIG. 9

FIG. 9

A. At four months.
B. At two years.
C. At five years.

the end of the treatment, the child is still so young that, if one fails in one's aim, there is time to try the ordinary methods.

In conclusion, let me emphasize that to improve the results of the treatment of congenital dislocation, one must *lower* the age limit for beginning treatment. But to render this possible, it is necessary for parents to learn to bring their children for medical examination early, and that the doctors shall be able to make the diagnosis in time. That will certainly occur in the future with suitable propaganda and with better orthopaedic training for the medical profession. In Italy we have already felt the benefit in this direction of compulsory orthopaedic instruction in the universities.

RECONSTRUCTIVE SURGERY IN PARALYTIC DEFORMITIES OF THE LOWER LEG*

BY MELVIN S. HENDERSON, M.D., ROCHESTER, MINNESOTA

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Anterior poliomyelitis usually occurs in the first decade of life. In approximately half of the cases its initial development is in both legs. Mitchell, in 1925, from the files of The Mayo Clinic reviewed 350 histories of patients who had had anterior poliomyelitis; 257 of these were treated surgically. Forty-four per cent. of the patients were aged less than three years at the time of onset; most of them came from the rural districts of the central portions of the United States and Canada, and they were mostly the victims of endemic anterior poliomyelitis. The distribution of the paralysis emphasized the significance of the leg and the foot in considering the disease (Table 1). The anterior tibial muscles were totally paralyzed in 158 cases and partially paralyzed in 302. The posterior tibial muscles were totally paralyzed in 105 cases, and partially paralyzed in 338. The peroneals were totally paralyzed in ninety-five cases and partially paralyzed in 279. The gastrocnemii were partially paralyzed in 375 legs, and totally paralyzed in thirty-one. Thus the anterior tibial muscles of the lower extremities were either completely or partially paralyzed in 460, the posterior tibial muscles in 443, the gastrocnemii in 406, the extensor longus digitorum in 377, and the peroneals in 374 legs. In these cases, as in Lovett's, the paralysis was worse in the distal portion of the lower extremity, whereas the reverse was true of the upper extremity.

The lower leg includes the structures from the knee down: the muscles of the tibia and fibula and their insertions, the ankle joint, and the bones of the foot and their associated joints. It is these structures that are dealt with when reconstructive surgery in paralytic deformities of the lower leg is considered.

The foot of the human being in its present evolutionary stage has reached a most satisfying efficiency. The foot and ankle not only must sustain more weight than any of the other joints, but it must encounter during locomotion all the inequalities and the different angles of surfaces that the subject elects to walk on. A most efficient member has been developed and when, through disease of one sort or another, its function is interfered with, the possessor of such a disabled member is seriously handicapped. When our ancestors ceased to live in trees, and were compelled to seek their livelihood by terrestrial instead of arboreal locomotion, a

*Read before the Joint Meeting of the American and British Orthopaedic Associations, London, July 5, 1929.

TABLE 1

THREE HUNDRED FIFTY CASES OF ANTERIOR POLIOMYELITIS (700 LOWER EXTREMITIES)*

Muscles	Degree of paralysis		Total
	Partial	Total	
Anterior tibial	302	158	460
Posterior tibial	338	105	443
Gastrocnemii	375	31	406
Peroneals	279	95	374

*Most of the cases were endemic, occurring in the first decade. The initial development was in the lower leg in about half of the cases.

considerable change in function was demanded of the foot; and with this, marked structural changes occurred. The supporting part was shifted to the posterior portion, leading to an increase in the size of the tarsal bones but to a decrease in the size of the digits. The great toe, losing its grasping function, increased in size and was forced forward, becoming incorporated in the longitudinal arch. The outer part of the foot with the digits was drawn in toward the first metatarsal. The powerful grasping muscles of the ancestral great toe became "steadiers" for the modern great toe, to hold it on the end of the metatarsal. The short flexors of the toes changed their origin to become attached to the os calcis and thus help maintain the arch, a structure which is of great importance and of much concern in this discussion. The plantar fascia became more important and was strengthened gradually. For example, the plantaris longus, in the arboreal period, extended over the heel to be inserted in the fore part of the plantar fascia. When terrestrial locomotion became standard, this tendon divided at the heel into a plantar portion and a leg portion, the distal portion of the former to retain its plantar insertion, but the proximal portion to be inserted in the inferior portion of the os calcis. The leg portion was inserted along with the tendo Achillis into the os calcis. Keith contends that the musculature is the chief supporting agent, whereas Morton believes that the arrangement of the bones and ligaments furnishes a stable base on which the weight of the body is supported with the least demand for muscular exertion. Occasionally, in case of a flail foot, although all the muscles below the knee are completely paralyzed, the patient is still able to walk without artificial aid. This fortunate state of affairs may be explained by the fact that there is still some power in the short flexors, and since they are not opposed, the muscle fibers contract just enough to give the needed support to the plantar fascia. Muscular action is very important from a postural standpoint, and tonicity of muscle is the deciding factor in the maintenance of the structure of the foot under weight-bearing. With the foot firmly planted on the ground, the muscles of the lower leg maintain

the balance of the body by their power of tilting the foot to keep the center of weight-bearing in the proper position. The muscles chiefly concerned in this are the tendo-Achillis group, and the tibial and the peroneal groups. The flexors and extensors of the toes have little to do with stability, although the flexors of the great toe are more important.

In the lower extremity, function and stability go hand in hand and although faulty muscle balance due to paralysis of certain muscles is the cause of the development of a deformity of the foot, the correction of faulty bone balance must be the first step to a cure. It has gradually been forced on us that transplantation of tendons without correction of bone balance is generally of no avail. The transference of tendons to restore the power of inverting or everting the foot has been generally unsatisfactory, for it does not give the stability desired. It acts best for flexion or extension. Much attention has been paid to drop-foot, but the victims of lateral deviation are the greater sufferers. Many persons with drop-foot get along well with simple appliances, but those with valgus and varus do not. I shall consider chiefly the latter group.

TABLE 2

STABILIZATION

Nerve	Ligament	Muscle	Bone
Neurotization; (method discarded)	Tenodesis; (application of method limited)	Tendon transplantation; (application of method limited)	Arthrodesis; astragalectomy; bone check
		Combinations of arthrodesis, tendon transplantation and bone check	

The restoration of stability and function in the paralyzed lower leg may be considered from four angles in reverse order as to their value: (1) the innervation of paralyzed muscles by the direct implantation into them of live nerves (neurotization); this method has not been successful; (2) support and stability furnished by the creation of new ligaments; tenodesis is an example that has been satisfactory in certain cases; (3) transference of the insertions of various muscles in suitable cases; and (4) an attack on the skeletal structure, such as osteotomy and arthrodesis; certain joints being fused, the bony architecture of the foot may be readily cast into more or less correct form for weight-wearing. Astragalectomy stands alone in that the removal of an entire bone is carried out as a basic procedure (Table 2).

NEUROTIZATION

The possibility of restoring function to paralyzed muscles by direct implantation of contiguous live nerves was an attractive theory, and it took considerable time to determine its value. There was just enough

clinical evidence showing a certain degree of success to raise hopes. Steindler was able to demonstrate in dogs that direct neurotization was possible, and that the muscle showed faradic excitability through the nerve. Unfortunately, the area of regeneration was distinctly limited, and whereas regeneration took place centrifugally from the site of implantation, it rapidly faded away and was lost in the wide expanse of the muscle. There appears to be no clinical value to the method and it has been abandoned.

LIGAMENTOUS SUPPORT

The employment of silk and linen for the purpose of forming artificial ligaments has been tried extensively. Some successful results occasionally follow, but the practice is so uncertain, in the foot at any rate, that it has been practically abandoned.

The use of fascia for reconstruction purposes is old. Codivilla introduced it and it was used by others; but more recently, through the work of Gallie it has been again popularized. Strips of fascia and tendon have been utilized for the stabilization of lax joints, such as recurring dislocations of the patella and the shoulder. It is of interest in this discussion because of the stabilization of the foot and ankle by the use of tendons of paralyzed muscles,—tenodesis. Codivilla advocated the subperiosteal attachments of such tendons to stabilize the foot. Vulpius advised the anchoring of these tendons under a peri-osseous flap. These methods, however, were unreliable, and it was not until Gallie showed the necessity of anchoring the tendon in a groove in the bone that the operation, properly executed, was proved to be successful and tendons did not, as was suspected, stretch. The apparent stretching of the implanted tendon is in reality due to a giving way at the point of anchorage, either to faulty anchorage, or to strangulation of the tendon by too much suturing. The method has probably not received the support it deserves because of unsatisfactory results in poorly selected cases, and lack of thoroughness in the anchorage of the tendon. Sufficient time has now elapsed to prove or disprove the method, and in the discussion today LeMesurier will speak of its use, and of the results and their permanency.

TRANSPLANTATION OF TENDONS

Although in 1882 Nicoladoni, and in 1900 Drobnik advocated transplantation of tendons, it was not until Codivilla's report in 1900 that the method was generally known. It ran the gamut of all kinds of tests, was used in poorly selected cases, and the technique was haphazardly carried out, little attention being paid to the physiologic aspect of the problem. The poor results, too often secured, led to more earnest study and investigation, particularly concerning the physiologic and biologic aspects. Sir Robert Jones, a pioneer in its use, early demonstrated its value.

We now know that transplantation of tendons has a definitely limited field, but the cases when carefully selected, with due regard to the limita-

tions of the method, have given a correspondingly higher percentage of good results. It has been found that attention must be paid to the strength of the muscle to be transferred. It is folly to demand of a muscle, which is in a new position and probably at some mechanical disadvantage and partially paralyzed, greater power, in order to be of any use, than it possesses in its normal state and native position. The tendon must not be led to its new insertion by a circuitous route, and thus lose much of its power. The tendon-to-tendon insertion of Vulpius has not been as certain in its results as the careful periosteal implantations, or better still, the fastening of the tendons directly into the bone. Deformity must be corrected, or the usefulness of the transplanted tendon will be thwarted. It has been found that in certain situations the method will convert a flexor muscle into an extensor muscle. This reversal of action is more apparent than real, because the original function of the transplanted muscle was in reality to give stability to the joint, and in its new situation it can be readily reeducated to do this, although acting as an extensor instead of a flexor.

Transplanted tendons sometimes fail to function in spite of careful attention to technique, and probably the chief cause of failure in such cases is that enough attention was not given to the tension of the muscle in its new position. There is no practical way whereby muscle tension can be accurately measured. If the transplanted tendon is so secured that there is too much tension, it fails to function well; nor will it function well if there is too much slack. The operator must develop a sense of fitness as to tension through experience. The tendon should be under enough tension, when transferred, to take up all the slack when the joint is in a position of correction. It is best not to gauge the tension with overcorrection of the foot. Whenever practical, the tendon sheath should be transplanted along with the tendon[2,8]. This is not always possible, nor is it essential, as evidenced by the many successful results without such technique. Delicacy in handling the tissues should be developed in such work, akin to that demanded of the neurosurgeon in his handling of the nerve trunks.

The main points essential to success are: (1) the proper selection of cases (very young children are not good subjects), both as to the local conditions and the psychic make-up of the patient; (2) the muscle of the tendon to be transplanted must be of sufficient strength and placed in a suitable position at a mechanical advantage to carry out its new duties; (3) proper anchorage of the tendon must be provided; and (4) after correction of the deformity, the tension of the muscles must be right. Reeducation, with the institution of proper measures of physiotherapy, should be started as soon as the initial trauma of the operation is quieted and the anchorage of the tendon firm enough to permit of contraction of the muscle.

METHODS OF STABILIZING BONE

Arthrodesis on the foot, although destructive of the physiologic action of the individual joints selected for attack, is nevertheless constructive

physiologically in that the function of the foot and lower leg is thereby augmented. Forced by the recognition of the limited field for tendon transference, there has been a gradual trend to stabilization of the foot by arthrodesis. The common form of arthrodesis concerns the astragalotibial, the astragalocalcanean, the astragaloscaphoid, and the calcaneocuboid joints, individually, and in various combinations. There have been developed certain standard practices of bony fusion for various paralytic deformities that have withstood the test of time.

Davis, in 1913, stressed the value of subastragalar arthrodesis for certain types of lateral instability. Gradually, from this basis of subastragalar arthrodesis have been elaborated more extensive procedures. Hoke advocated, along with arthrodesis of this joint, resection, reshaping, and remodeling of the head and neck of the astragalus, with backward displacement of the foot. Albee advocated, for certain cases, panastragalar arthrodesis, wherein all joint surfaces of the tibia, fibula, astragalus, scaphoid, and os calcis were removed and union produced. It is applicable in cases of flail feet if the knee and hip are sound, although some state that paralysis of the quadriceps extensor of the knee is not incompatible with good results. Triple arthrodesis, advocated by Ryerson, wherein astragalocalcanean arthodesis with arthrodesis of the astragaloscaphoid and calcaneocuboid is carried out, has won a deservingly increasing field of usefulness. In dealing with some feet, Ryerson pointed out that the cuneiform-scaphoid joint may be included in the plan.

The arch of the foot is divided into two unequal parts, a long anterior and a short posterior, the ratio being six to one. Consequently, in paralytic conditions, particularly when the tendo-Achillis group is affected, it is often necessary to shift the line of weight-bearing nearer the center of the foot. This can be done in Hoke's operation, but very little in this way can be accomplished in ordinary triple arthrodesis. The procedure advocated by Dunn, wherein the anterior portion of the longitudinal arch is shortened, does permit of this. In Dunn's operation, on the outer side contiguous portions of the os calcis and of the cuboid are removed; on the inner side all of the scaphoid and a portion of the head and neck of the astragalus are removed. The os calcis and astragalus are separated and the articular surfaces resected for arthrodesis. The foot is displaced backward by allowing the astragalus to rest on the cuneiform bone, and the os calcis and cuboid come in contact. In all forms of arthrodesis of the foot, the utmost care must be taken to see that the foot is put up in slight valgus. Even slight varus in a rigid foot must be avoided.

The operations which have been described are all intra-articular procedures. Extra-articular methods, with the use of bone grafts in various ways, have been found wanting and abandoned. Osteotomy of the lower leg to correct torsion deformity must be done occasionally; likewise, in certain deformed feet it may be necessary to remove a wedge of bone only to correct a varus deformity, oftentimes resulting in splendid stability and function.

Whitman, in 1901, advocated astragalectomy for the stabilization of paralytic feet and in properly selected cases no other operation gives better results. A foot in which a few years before severe calcanean deformity had been present, but which now appears almost normal after astragalectomy, is convincing proof that the operation is an excellent one. The weight is transferred to the middle of the foot; the greatly shortened plantar structures yield gradually under weight-bearing to stretch the foot out, so that it is difficult to believe that the astragalus has been removed. The technique as described by Whitman should be adhered to and his important admonitions, that the foot must be displaced backward and the cast applied with the foot in slight equinus and valgus, should be kept in mind. Poor results are due to faulty selection of cases, to improper technique or to postoperative fixation. The best results are obtained in pes calcaneus and calcaneocavus. The operation gives stability to the foot, with sufficient motion at the ankle for comfortable walking.

"Bone-check" operations may be quite useful. My experience with Campbell's bone-block operation for drop-foot, often done in conjunction with triple arthrodesis, has been most satisfactory. Although technical failure may ensue, increased experience soon gives better results. I have not had any experience with Putti's anterior bone-check operation for

TABLE 3

INFANTILE PARALYSIS OF FOOT AND ANKLE*
(Operations 1924 to 1928 inclusive)

Operations	Total	1924		1925		1926		1927		1928	
		Operation	Per cent.	Operation	Per cent.	Operation	Per cent.	Operation	Per cent.	Operation	Per cent.
Arthrodesis	60	3	5.9	12	30.8	19	40.4	13	38.2	13	54.2
Arthrodesis and tendon transference	46	6	11.8	8	20.5	12	25.5	13	38.2	7	29.2
Manipulation and tenotomy	42	16	31.4	8	20.5	12	25.5	4	11.8	2	8.3
Astragalectomy	23	9	17.6	9	23.1	2	4.3	2	5.9	1	4.1
Tendon transference	11	8	15.7	1	2.5	1	2.1	1	2.9		
Osteotomy, removal of wedge of bone	10	7	13.7			1	2.1	1	2.9	1	4.1
Osteotomy and tendon transference	3	2	3.9	1	2.5						
Total	195	51		39		47		34		24	

*Campbell bone block for drop-foot in 25 cases

TABLE 4

RESULT OF OPERATION: PERCENTAGE OF PATIENTS TRACED IN EACH GROUP

Operation	Cases	Patients traced	Good		Fair		Poor	
			Cases	Per cent.	Cases	Per cent.	Cases	Per cent.
Arthrodesis	60	49	47	95.8			2	4.1
Arthrodesis and tendon transference	46	44	43	97.7			1	2.3
Manipulation and tenotomy	42	30	27	90.0			3	10.0
Astragalectomy	23	19	16	84.2	1	5.3	2	10.5
Tendon transference	11	9	8	88.8			1	11.1
Osteotomy, removal of wedge of bone	10	10	8	80.0			2	20.0
Osteotomy and tendon transference	3	2	1	50.0	1	50.0		
Total	195	163	150	92.0	2	1.2	11	6.7

calcanean deformity. Although it probably has a limited field, Putti's results show its usefulness.

In The Mayo Clinic, from 1924 to 1928 inclusive, there were seen 729 cases of residual paralysis following anterior poliomyelitis. Upon 174 of these, 195 operations were performed to restore stability to the foot and ankle. Tables 3 and 4 represent a synopsis of the work done. It may be noted that there has been a gradual decline in the number of cases in which operation was performed, and this in spite of an increase in the total number of patients taken care of in the orthopaedic section of the Clinic. Several factors serve to explain this. Most of the victims of previous large epidemics have been taken care of, and the increase in the number of well manned orthopaedic hospitals in this country places facilities for the proper care of such patients in an increasing number of centers. There has been a gradual trend in favor of arthrodesis (Table 3), 54.2 per cent. in 1928 as against 5.9 per cent. in 1924 and a falling off in the number of operations of astragalectomy, 17.6 per cent. in 1924 and 4.1 per cent. in 1928. There has been also an increase in the combinations of arthrodesis and tendon transferences: 11.8 in 1924 and 29.2 in 1928. It is difficult to determine the results of operation unless one has the opportunity of carefully examining patients, for very often the stabilizing procedures on the foot are merely a part of a number of measures to increase the function of the leg. In charting the results as fairly as possible, I was rather sur-

prised to find that the different operations in individual cases seemed to accomplish what they were intended to accomplish in the vast majority of instances. In spite of this, however, owing to poor selection, some derived small benefit so far as getting about was concerned. The poorest results were among those cases wherein osteotomy or tendon transference only was performed, and the best results were obtained following arthrodesis and combinations of arthrodesis and tendon transference. In twenty-five cases the Campbell bone-block operation was used in addition to triple arthrodesis. When this is properly done, enough bone being placed on the os calcis and the block carried high enough, the method gives very satisfactory results and prevents drop-foot better than any method which I have used.

The combination of tendon transplantation and arthrodesis is, one might almost grant, a solution of the problem of lateral instability of paralyzed feet. This was emphasized by the Commission appointed by the American Orthopaedic Association when it made its report in May 1922[16]. The concluding paragraph was as follows: "The Commission would urge that tendon transplantation be almost universally supplemented by stabilization of enough of the smaller joints of the foot to prevent or correct all tendency to varus or valgus deformity, since the examination of a large number of postoperative cases has shown that the lateral deformities are of much greater importance than drop-foot".

CONCLUSIONS

The foot of man has been gradually developed from an arboreal grasping to a terrestrial weight-bearing member. Changes in bony structure, forced by altered function, have gradually taken place, the heel has lengthened, the tarsal bones have increased in size and significance, while the digits and metatarsals have decreased. The muscles are balancers and have by their action led to structural changes and are prime factors in the stability of the foot of man. When, through paralysis, the muscles lose their tone and power, there may be disastrous sequelae in the foot, and restabilization must be undertaken. Restoration of nerve supply to the muscles by neurotization has not been successful. Tendon transference, whereby the insertion of a functioning muscle is transferred to another insertion, may, in selected cases, do much to restore function. Support by paralyzed tendons, tenodesis, has a limited field. Artificial silk or linen ligaments are not satisfactory in the foot as a rule. Stabilization by means of the bony structure of the foot offers the widest and most useful field for reconstructive surgery, the various and varied forms of arthrodesis, the astragalectomy of Whitman, and the bone-check operations of Campbell and Putti being examples. The combination of tendon transference and arthrodesis to give stability serves both to enhance the value of the tendon transference procedures and the arthrodesis.

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THE COMPENSATION TREATMENT OF SCOLIOSIS*

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In contrast to the usual current methods, the compensation treatment of scoliosis, as advocated by the writer on previous occasions, is not concerned with the application of direct force to correct the scoliotic deformity. It rather aims at realignment of trunk and body as a whole, by means of compensatory, secondary curves, developed systematically in the adjacent sections of the spine. A certain degree of mobility must be imparted to these sections in order to produce the secondary curves. After body balance has thus been restored, it is the further aim of this treatment to maintain realignment by active muscle power. To this end the musculature must be brought to a point of full control of body posture, and the degree of mobility or relaxation to be imparted by this treatment to the non-scoliotic sections is conditional, at any time, upon the momentary state of the muscles of the back.

The treatment, therefore, rests upon two cardinal points: (1) symmetry is restored indirectly by the use of compensatory curves and not directly by correction of the scoliosis; and (2) such relaxation of the spine as is necessary to produce these secondary curves, must be carried out under constant surveillance so that it may not exceed the ability of the active muscular apparatus of the spine to control it.

Restoration of body balance by developing compensatory counter curves is not a new conception. It was expressed by Lorenz and Schede; it is tacitly implied in many of the earlier writings on the subject, and it is given definite recognition by Lovett when he emphasizes the fact that it is easier to displace the scoliotic spine *en bloc* than to correct it. It is, moreover, a definite physiological feature in the natural life and development of scoliosis. It is nature's automatic reaction against loss of body balance, and represents an attempt to cure the deformity. We find, however, that nature's ability to restore body balance by compensation and to maintain it by active muscle force has its narrow limits. Only a minority of cases of structural scoliosis come to automatic arrest by this process of active self-correction. By far the larger portion of cases develop too rapidly to be checked definitely by this natural reaction.

The factors which determine this degree of natural compensation are essentially the same as in other manifestations of Wolff's law of functional adaptation; constitution, intensity of growth, site and length of the curve, are the fundamental elements in the functional adaptation of the spine.

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As we draw a parallel, however, between the counter curves seen, for instance, in the long bones of the body and those observed in the human spine, certain reservations must be made in accordance with the different anatomical and biological situation. With the exception of congenital, and the rare traumatic cases of scoliosis, the rôle of the skeletal parts of the spine in producing the deformity is secondary, no matter how abundantly evident the morphological and structural changes in the spinal column may be. The primary changes are those of the muscular and ligamentous apparatus of the spine. It cannot be emphasized too strongly that it is the musculature of the spine and thorax, the ligamentous apparatus of bodies and arches, as well as the vertebral and costovertebral articulations which sustain the immediate effects of loss of balance and symmetry. These structures are similarly subject to the action of physical forces and show a type of reaction analogous to that seen in bone; but unlike

FIG. 1-A

FIG. 1-B

A. Spontaneous compensation. Symptomless.
B. X-ray of Fig. 1-*A*.

FIG. 2
Active mobilization. Creeping exercise.

the vertebrae, muscles and ligaments have a high elasticity coefficient, and acquire readily marked structural deformation to which they also offer a considerable resistance. This resistance is a definite factor in the production of the new and pathological balance, replacing the old and normal one. One should think of scoliosis similarly as of other conditions of disalignment of the body, namely, as a play between loss and recovery of balance, as a strife between the opposing influences of external gravital forces and resisting, intrinsic forces, in order to appreciate the natural behavior and propensity of the scoliotic spine.

One of the fallacies commonly taught is that, when symmetry of the spine has once been lost, the deformity must irresistibly increase and progress under the stress of gravital laws. We find, on observation, that this is not true. Structural scoliosis not infrequently comes to an early arrest spontaneously under the development of secondary, or counter curves (Figs 1-A and 1-B). Particularly favorable for permanent automatic arrest are cases with short curves of high location, endowed with a strong body musculature; cases of the heavy, stocky types which have passed the period of rapid growth. It has been pointed out that the great majority of scolioses are unable to meet the prerequisites for permanent natural arrest and that they progress to advanced stages of decompensation or disalignment. In restoring these cases to a state of general body balance, the compensation method strictly follows the footsteps of nature by establishing secondary compensatory curves. It would seem that this method, in its studious avoidance of direct corrective forces, places itself in strong contrast to the generally accepted current method of forcible correction. In reality the contrast is more theoretical than real. The interrelation which exists between correction, compensation, and maintenance of balance explains this point.

Forcible correction becomes effective upon the primary curve only as it reaches a degree sufficient to break the resistance of the very rigid

scoliotic section of the spine. Up to this point its efforts are spent upon the less resistant neighboring portions of the spine which respond to it by formation of compensatory curves, both lateral and rotatory. Accordingly, there is a vast difference whether a method be applied in a mild or a more severe form. Only the most vigorous methods (Schanz, Abbott) are purely corrective. In all the others the correcting forces are being so mitigated that one should speak of them as compensating rather than as corrective. They only differ from the compensation method as advocated by the writer in the manner in which the realigning force is applied in the latter,—namely, in its application to the non-rigid sections of the spine and in the preservation of the original curve, the stability of which is held as an asset in the scheme of body balance.

What happens if the force is sufficient to break the rigidity of the primary curve? A state of relaxation of the spinal column results which must mean a tremendous additional burden for the balancing musculature. The current methods of forcible correction may be divided into traction and pressure methods on one hand, and the derotation and inclination methods on the other. In the traction and pressure methods (Schanz, Wullstein, Abbott), the relaxation of the spine is comparatively rapid, and there remains, under the mechanical arrangement, no opportunity to establish secondary curves.

FIG. 3-A

FIG. 3-B

Active mobilization.
A. Relaxed.
B. Shifted

In the inclination and derotation methods (Forbes, Klein, Calvé, Galeazzi), the force applied first takes effect upon the movable sections of the spine, but as it increases, the scoliotic section begins to yield in proportion to its structural rigidity. Herein lies the significance of Lovett's observation that "it is easier to displace the scoliotic section *en bloc* than to correct it". Displacement, *en bloc*, means displacement by compensatory curves.

Furthermore, there is to be considered the secondary effect of the compensating curve upon the primary curve. True enough, this curve, on the whole, is too rigid to be broken by the moderate force applied to procure compensatory curves, but this holds true, strictly speaking, of the central portion of the curve only; its extremities, being more pliable, are drawn into the secondary curves as the latter become developed, and this applies both to the lateral and rotatory element of the deformity. We note, accordingly, that curves of moderate rigidity, as their peripheral portions are being absorbed in the counter curves, become shorter. Assuming that the resistance of the primary curve is very slight or absent, as is the case in beginning structural and physiological curves, then, under compensation attempts, both inclinatory and rotatory, the entire curve will become absorbed in a counter-curve representing the converse deformity. There can be no danger, therefore, that a simple, physiological curve may ever become converted into a triple curve under the compensation treatment. This would be impossible from the viewpoint of sheer mechanics. The development of counter-curves presupposes the existence of a fixed point within the primary curve, against which the secondary curves, above and below, are being established. Physiological curves, therefore, must revert to their converse deformity and, by way of overcorrection, symmetrical balance is ultimately established.

So much for the mechanical problem of realignment. The dynamic problem involved in the compensation method is the maintenance of this alignment by active muscle balance. Here, the method rests entirely upon an adequate development of the body musculature. In the last analysis the mechanical feature of realignment is subordinate to the dynamic postulate of muscle development. The development of the secondary curves is effected by a rather simple and elementary program of active and passive exereises. The development of the musculature is carried out by a much more protracted and varied system of symmetrical and asymmetrical gymnastics, supported by massage.

TECHNIQUE

In accordance with these principal objectives, the treatment embraces a threefold program: *A*. a program of mobilization of sections of the spine in order to produce counter-curves and to rearrange the body balance; *B*. a program of stabilization by adequate mechanical support; and *C* a program of muscle development and muscle education in order to maintain actively the balance so regained.

There is no strict chronological sequence of these programs, as they are carried out, more or less, concurrently.

A. The mobilization of the spine is effected by a system of active and passive motion. The active mobilization exercises consist principally in creeping, body-shifting, and spring-sitting exercises. Passive exercises include body-swinging, manipulations of the pelvis (Figs. 2, 3-A, 3-B and 4) carried out on the plinth and on the oblique Zander seat, and, for derotating, on a specially constructed derotation apparatus (Dr. Grieve), which holds the thorax immobilized, and imparts rotatory movements to the pelvis and lumbar spine.

In view of the employment of passive forces, one may object that this method should also be classed among those of forcible correction. But it is precisely because even these passive exercises are thoroughly dominated by the momentary conditions of the muscular apparatus, that this method is not one of passive forcible correction. Never is pliability or relaxation of any section of the spine permitted to develop in excess of actual muscular control. In this point lies the distinct difference of this compensation method from the forcible correction methods which allow relaxation of the primary curve to be produced without adequate muscular control. Some orthopaedists maintain that active muscle control can be subsequently developed over the relaxed portions (Schede, Galeazzi). From the writer's observation of the late results of Galeazzi's treatment, he is inclined to believe that maintenance of active balance following forcible correction is a possibility, if correction is very gradual, relaxation consequently slight, and if a very extensive program of muscle education follows the correction, as is the case in Galeazzi's method. As a general rule, however, it is the writer's experience that incontrollable collapse follows forcible correction.

FIG. 4
Passive mobilization. Rotation apparatus. (*Dr. Grieve.*)

B. Stabilization of the spine.

Stabilization of the realignment of the body obtained by active and passive mobilizing exercises and manoeuvers is more generally entrusted to a brace of the

so called standard body type, which carries an extension including hip and thigh on the side opposite the primary curve. Cast or brace are based in their construction upon simple mechanical principles. Since disalignment is caused by overhang of the body to the scoliotic side, and by the shift of the pelvis to the opposite, realignment in the frontal plane necessitates replacement of the body toward the concave side and a shifting back of the pelvis to the side of the primary convexity. The rotatory compensation is likewise expressed by the rotation of the pelvis backward on the side opposite to the primary curve. Hence, it is obvious that the pelvis is not a fixed part but a decidedly movable portion of the mechanical system, and that it, therefore, must be included and fully controlled in the stabilizing apparatus.

Twenty years ago the writer first described a brace of this type which takes into account the necessity of controlling the pelvis by extending the apparatus to include the thigh. We are now making it a practice to apply a brace early in the treatment during the mobilization manoeuvers, usually

FIG. 5-A

FIG. 5-B

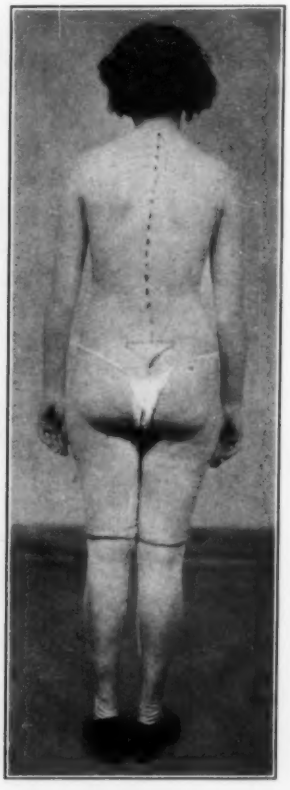

FIG. 5-C

Compensation series. Structural scoliosis.
A. May 16, 1925.
B. July 7, 1926.
C. April 24, 1929. Holding.

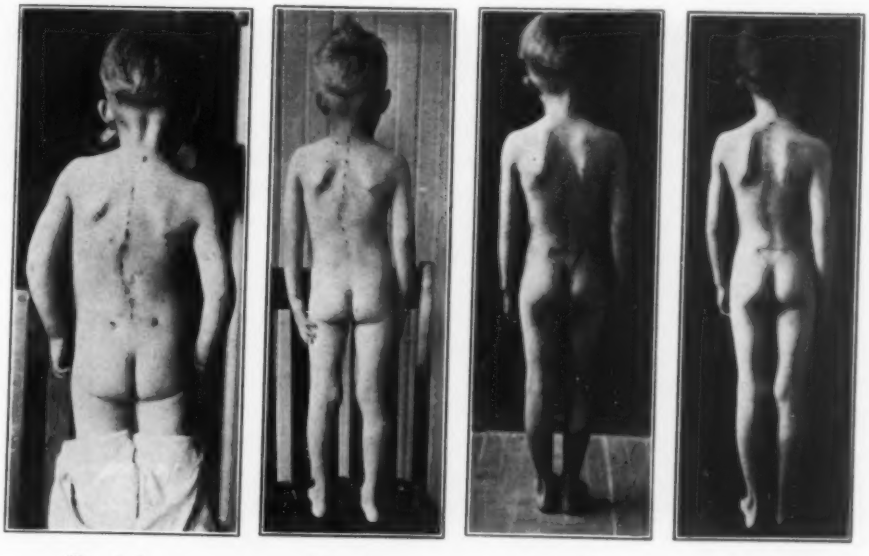

FIG. 6-A FIG. 6-B FIG. 6-C FIG. 6-D

Compensation series. Congenital scoliosis.
A. April 9, 1925.
B. June 10, 1926.
C. June 6, 1928.
D. January 24, 1929. Holding.

FIG. 7
Case of Fig. 6. Hemivertebra twelfth dorsal.

within a week or two after beginning the exercises. Such a brace is to be worn continuously, only to be removed for the periods of treatment.

C. Maintenance of Compensation.

Active maintenance of compensation depends upon the condition of the musculature of the back and of the body as a whole. For the development of the muscles of the back, symmetrical exercises are especially important. Such exercises also are instituted early in the treatment while the formation of the compensatory curves is under way.

The period of time necessary to produce realignment varies greatly; sometimes several weeks are sufficient; often several months, and even a year or more, are necessary to produce satisfactory secondary curves. The efforts to produce satisfactory compensation should not be abandoned too early, and one should proceed as long as improvement in the alignment of the body can be obtained.

Muscle exercises for maintenance of body alignment must be continued for even much longer periods, in most cases for years, and each patient should receive adequate training and explicit enough instructions to enable him to carry on his program of muscle development at home.

We have applied the method of compensation to approximately 150

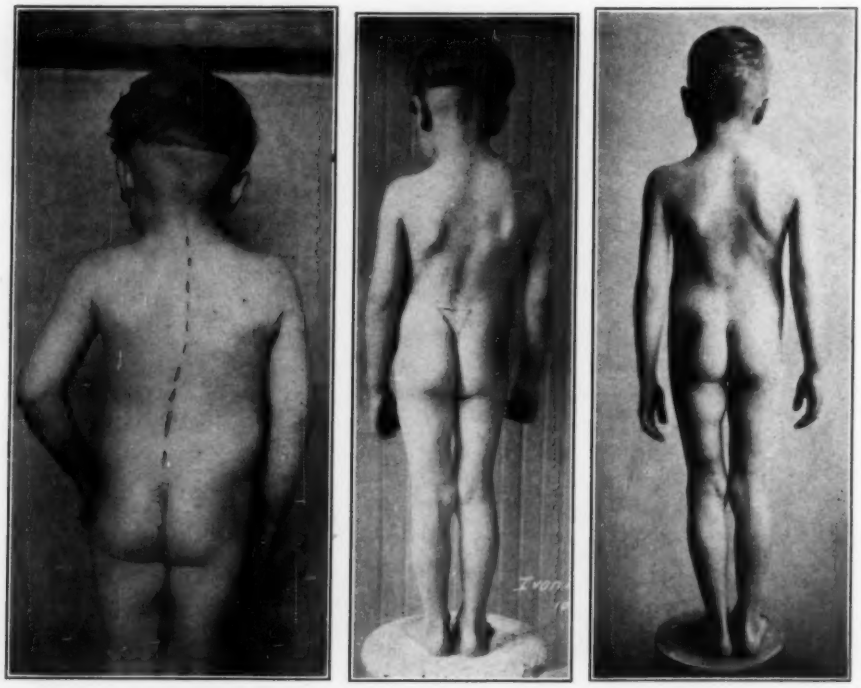

FIG. 8-A FIG. 8-B FIG. 8-C

Compensation series. Congenital scoliosis.
A. April 7, 1925.
B. October 26, 1926.
C. May 3, 1929. Holding.

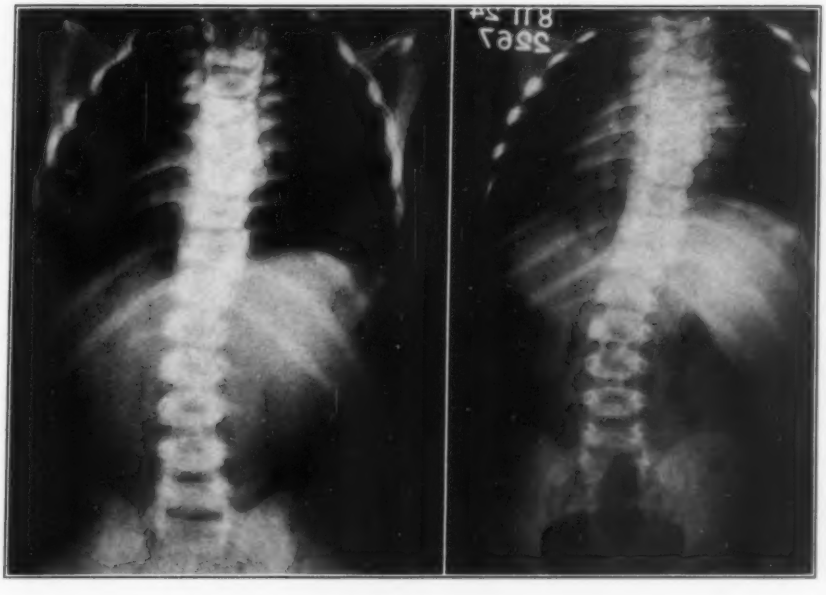

FIG. 9

Case of Fig. 8. Left, 1924; right, 1929. Hemivertebra, first dorsal, second dorsal, seventh dorsal.

judiciously selected cases of scoliosis. In general terms the effect of the treatment was as follows:

Physiological and non-rigid scoliosis responds by reversion of the curve and ultimately returns to symmetry.

Structural scoliosis, up to a certain degree of rigidity, responds by the formation of S-shaped, or triple curves of the converse order. Length and location of the curve greatly determine the possibility of establishing satisfactory counter-curves. Higher and shorter curves are more easily compensated. Beyond a certain point of rigidity, satisfactory formation of counter-curves is no longer possible without sacrificing the stability of the primary scoliotic section. Forcibly relaxed curves are likely to result in ultimate collapse.

It appears, therefore, that the method of compensation treatment alone is suitable only for a specified range of cases. On the other hand, we have found it a very valuable preparatory step in a group of cases in which definite maintenance of correction has to be procured by other means,—braces or operative fixation. All in all about fifty per cent. of all cases of scoliosis, as they presented themselves in the clinic, were considered suitable for this type of treatment.

INDICATIONS

I. *Types in which compensation treatment alone is adequate.*

From the viewpoint of the clinical classification, compensation treatment was found appropriate and sufficient in the following types:

a. In the functional and postural scolioses. This type included about ten per cent. of the scoliosis material.

b. In structural scoliosis of the habitual type, in mild and moderate degrees of rotation or lateral deviation; this group comprises thirty or forty per cent. of all cases under observation; these cases developed satisfactory compensation and maintained it (Figs. 5-A, 5-B, 5-C).

c. In paralytic scoliosis of the milder type with slight involvement of the back muscles. Here, also, it was possible to maintain balance after compensation by especially vigorous muscle education.

d. In some cases of congenital scoliosis; high location of the primary curve is especially important for the production of satisfactory compensation (Figs. 8-A, 8-B, 8-C and 9).

e. In early or late rachitic scoliosis of moderate degree.

II. *Types of scoliosis in which compensation proved a valuable aid preceding operative fusion.*

It has been our observation that the realignment of the body by compensatory curves is essential to successful fusion. A very large number of our cases fused by the Hibbs method (over 100 cases) showed a subsequent break or pseudarthrosis formation in the dorsolumbar level, because of the excessive strain caused by the "overhang" in non-compensated curves. To this group of cases belong a number of the severer paralytic cases which are still capable of passive realignment by compensation.

III. *Types in which compensation treatment fails.*

a. The severest types of habitual scoliosis.

b. The majority of cases of congenital scoliosis.

c. The severer types of paralytic scoliosis.

d. The severe types of rachitic scoliosis.

CONCLUSION

After observing the results of the compensation method for more than four years on about 150 cases, we feel free to assert that, in properly selected cases, a return to normal body balance by way of mobilization, compensatory curves, and satisfactory development of the active muscle power of the spine, is indeed possible. Because it preserves the function of the spine, this treatment seems to us a more natural and more desirable solution than the one offered by methods of forcible correction or operative fusion. At the same time, it is recognized that only a portion of the cases of scoliosis are suitable for this type of treatment. Yet it is, we believe, a matter of satisfaction to return a not inconsiderable proportion of cases to normal balance and complete muscle control, which otherwise would have been relegated to operative fusion, or an indefinite period of brace support. It is admitted that in failing to produce local correction of the primary curve, the immediate cosmetic results of the method seem to fall behind those of forcible correction. This, however, is more than offset by the reliability and permanency of the compensation results, and by the advantage of active and lasting muscular control of the spine.

THE PREHALLUX (ACCESSORY SCAPHOID) IN ITS RELATION TO FLAT-FOOT.*

BY FREDERICK C. KIDNER, M.D., DETROIT, MICHIGAN

The prehallux is a supernumerary bone which occasionally appears in the human foot, attached to or fused with the inner border of the scaphoid. It is usually described as lying somewhat behind and below (Monahan, Froelich). In my experience, and as described by Dwight, it usually lies directly internal to the scaphoid. When it is present, the tendon of the tibialis posticus, on its way to its final insertion in the internal cuneiform and metatarsals, attaches to it, instead of to the under surface of the scaphoid tubercle (Keith). This relationship is the cause of its influence on flat-foot and determines the principal theme of this paper.

The bone was first described by Bauhin in 1605 (Froelich). Pfitzner in 1896 gave a very full account of it and named it, for reasons of comparative anatomy, the os tibiale externum. It has also been called, in the rather extensive literature, the accessory scaphoid. In the earlier literature it was sometimes mistakenly described as a sesamoid bone, or as a fracture of the scaphoid. Until the advent of the x-ray the bone remained a mere anatomical curiosity, and no attention was paid to its possible effect on the function of the foot.

The origin of the bone is undoubtedly evolutionary. It appears in many of the lower mammals in a greater or less degree of development, and with greater or less functional importance. Froelich speaks of it as "atavistic debris" and quotes Thilenius to prove that it is a true supernumerary bone and not a sesamoid, because it often has a true articulation, with hyalin cartilage and ligaments, between it and the scaphoid. This joint may be more or less fully developed, or the bone may be completely fused with the scaphoid (Dwight, Pfitzner). The most interesting article on the bone that has come to my attention is that by Monahan in 1920. He suggests two possible theories to explain its presence:—first and most probable, that it is a direct evolutionary descendant of the prehallux or sixth toe, in such lower vertebrates as the echidna and opossum:—second, that it is a progressive evolutionary effort of nature to reenforce a weakening and pronating foot arch. Monahan draws attention to the frequent relation of flat-foot and other foot troubles to the presence of the prehallux. Although his theory that the bone is a degenerated evolutionary remnant is undoubtedly correct, his conclusion that it is dependent for its appearance on chronic disease is unquestionably wrong. This conclusion he bases

*Read at the Joint Meeting of the British and American Orthopaedic Associations, London, July 6, 1929.

on his mistaken observation that the bone does not occur before adult life, whereas it is really congenital and is recognized in the foetus (Dwight, Pfitzner). It is because of the importance of this article that I have chosen to retain the name "prehallux".

Since the advent of the x-ray the prehallux has been recognized during life, with increasing frequency. Its bearing on foot function has been considered by different groups of men from three points of view. The first group—composed of Haglund, Lilienfeld, Gaugele, and Froelich—lay emphasis on its relation to an everted or flat foot. Froelich advises its removal for this cause alone. A second group—Geist, Froelich, Rendu and Pouget, Mouchet, and others—emphasize painful conditions occurring at the site of the prehallux, either as inflammatory reactions, or as the results of continued trauma on an abnormal bony prominence or abnormal joint. Haglund spoke of a peculiar tarsalgia due to the irritating pressure of the bone. A condition resembling Köhler's disease has been described. Bursitis and arthritis, either traumatic or infectious, occur. For all these conditions rest and heat are usually prescribed, followed if necessary by the removal of the bone. These latter conditions I shall consider no further but shall confine myself to the relations to flat-foot.

Fifteen or more years ago a young woman came to me with pain over the inner ends of her very prominent tarsal scaphoids. This was so great that she could not bear the pressure of her shoes. She also had markedly flat feet. I recognized double prehallux and agreed to remove them because of the pain. At operation the prehallux was found to carry the main attachment of the tibialis posticus. The bone was carefully dissected out and the attachment of the muscle allowed to fall outward against the scaphoid. It was noticed that this procedure straightened the line of pull of the tendons. The operation was of course successful in stopping

FIG. 1

Typical case of ununited prehallux in a child.

FIG. 2

Typical case of united prehallux in a child.

the pain. It was with great surprise that a marked improvement in the flat-foot was noted. A fairly good longitudinal arch developed. This fact was attributed at the time to the complete rest following the operation. This successful case led to the repetition of the operation in a few adults who had prehallux and flat-foot. These feet showed the prehallux as a separate bone, or as a fused continuation of the inner end of the scaphoid. They showed consistently the abnormal attachment of the tibialis posticus tendon to the extreme inner tip of the bone. Gradually these facts so impressed themselves, that we began an organized study of the condition at the Children's Hospital of Michigan, with the following results:

Prehallux frequently occurs in children. It may be so small that the normal leverage of the tibialis posticus is maintained, and there are no flat feet or other symptoms. The prehallux may be free with a well developed joint between it and the scaphoid (Fig. 1), or the two bones may be fused (Fig. 2). In all cases observed in which the prehallux was of any considerable size the tendon of the tibialis posticus was displaced inward by its attachment to the inner side of the bone. In all such cases full adduction of the foot brought the prominent inner end of the bone into close and sometimes painful relation with the internal malleolus. All such cases had marked flat-foot with symptoms of foot strain. In one or two cases, where the prominence of the prehallux was very small, there was no noticeable inward displacement of the tendon and no flat-foot or other symptoms. The ages of the patients ranged from two and one-half to twelve years. They did not include cases seen in private practice nor adults. Both of these, however, show the same phenomena, notably Figure 5, a man of fifty-five years.

From these observations we have evolved a theory to explain the relation between flat-foot and the prehallux. First, the attachment of the tibialis posticus tendon being displaced upward and inward, the line of its

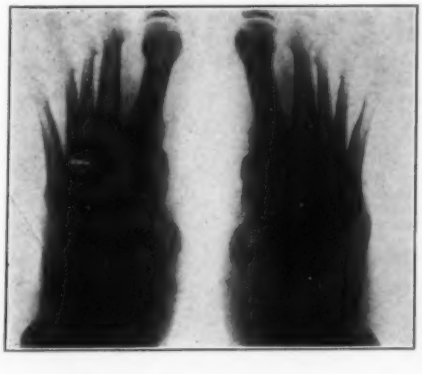

FIG. 3

Adult prehallux, united on one side but not on the other.

FIG. 4

Line of posterior tibial tendon in the presence of prehallux.

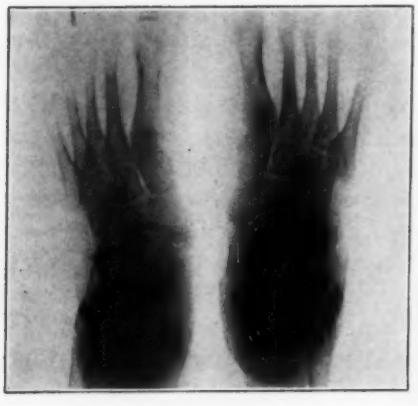

FIG. 5

Typical case mentioned, man fifty-five years old. X-ray before operation.

FIG. 6

Same as Fig. 5. X-ray after operation.

pull is changed. Instead of pulling directly upward, as it does when attached to the lower surface of the scaphoid, it is forced to pull backward and inward at an angle and becomes an adductor instead of a supinator. This of course makes it work at a mechanical disadvantage and it must work harder to accomplish an equal lift on the tarsus. Second, the long lever arm of the prehallux extending inward forces the muscles to greater lineal contraction in order to produce a given amount of lift at the center of the arch. In other words, the lifting effect on the arch is reduced—first, by the angulation of the line of pull; and second, by the longer distance through which the pull must act. Third, the effort to lift the arch or to adduct the foot is very quickly stopped by the close approach of the prehallux to the internal malleolus. This approach produces an insuperable mechanical obstacle. Fourth, the crowding of the tissues between the prehallux and the internal malleolus leads to discomfort which is automatically relieved by abduction. These last two points of our theory explain the improvement in flat-foot which we have seen and which others, notably Froelich, have observed follows the simple removal of the prehallux.

Working from the theoretical consideration just stated, we have evolved an operative procedure which we believe to be original and successful. An incision is made along the course of the tibialis posticus tendon, with its center at the prehallux. The tendon is freed upward for one and one-half inches. Below it is freed for one-half inch by an artificial dissection of the fibers going to the cuboid and metatarsals. With a thin osteotome, a thin layer of bone is cut off the prehallux, thus mobilizing the tendon. Then a piece of bone which includes the whole prehallux, in the cases where that bone is free, or a corresponding amount of the scaphoid, if it is fused, is removed. More bone is removed below than above. The

tendon with its thin sliver of bone is then transplanted downward so that it is in contact with the freshly cut under surface of the scaphoid. It is held in this position by chromic sutures (two or three) through the adjacent ligamentous tissues. This transplantation is carried out with the foot in almost full supination. The wound is then closed in the usual manner and the foot put up in plaster in full supination with a moderate amount of cavus. Fixation is maintained for six weeks and then physiotherapy started, with gradual return to weight-bearing in a shoe with a lift on the inner side of the heel. It is found that the transplanted tendon, even under a general anaesthetic, will hold the foot in correct position before the application of plaster. The description of a typical operation follows.

W. M. A.: Age twelve years, colored, operated upon February 22, 1929. Incision was made in the line of the posterior tibial tendon across the tip of the prolonged scaphoid to the cuneiform. The tendon was found to be attached to the inner margin of the tip of the scaphoid instead of to the under surface. Its fibers were directly continuous to the internal fascia between the scaphoid and the cuneiform. In fact these fibers seemed to provide a second attachment. The tendon was dissected free for about one and one-half inches upward. It was then found that supination of the foot entirely changed the line of the pull of the tendon so that it must pull outward instead of upward. Even this pull became impossible in the mid-position and the tendon simply folded up between the tip of the scaphoid and the external malleolus. This was true, too, of the scapho-astrogaloid ligament. The attachment of the tendon to the scaphoid was lifted off with an osteotome, taking a thin layer of bone with the under surface of the tendon, which was left attached to the cuneiform. A thick chip of bone was then removed from the inner end of the scaphoid. This exposed the inner part of the head of the astragalus. It was then possible to supinate the foot fully without the soft parts being squeezed

FIG. 7

Photograph of a typical case after operation, taken in normal standing position.

FIG. 8

Showing voluntary power of over-correction.

between the scaphoid and the malleolus. A deep stitch was then taken through the plantar fascia and the tendon, pulling the tendon downward beneath the new surface of the scaphoid so that action in the future would be that of a sling with better leverage for its posterior upward pull. The stitch was placed with the foot two-thirds corrected. Ligaments and fascia were then resutured, holding the tendon firmly in its new bed. The bone left on the outer surface of the tendon was left in contact with the raw under surface of the scaphoid. On the right foot in which the scaphoid was less prolonged inward, the only variation was that the slack in the tendon was taken up by sutures. Fascia and skin were then closed with catgut. Foot was put in overcorrected position. It was noticed that when the tendon was sutured in its new bed it held the foot in a three-quarters corrected position even under the anaesthetic.

The results of this operation have been uniformly successful in improving flat feet where prehallux is existent.

We feel that further study of the attachment of the tibialis posticus should be undertaken in flat feet where prehallux is absent and that more careful x-ray search for prehallux should be made in all flat feet.

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CLEIDOCRANIAL DYSOSTOSIS: HEREDITARY AND FAMILIAL

BY SETH M. FITCHET, M.D., F.A.C.S., BOSTON

The syndrome, "cleidocranial dysostosis", described and named by Marie and Sainton in 1897, is a relatively rare condition and so little understood that it seems not inappropriate to review our present knowledge of the subject, as found in the literature, and to attempt to clarify what understanding we may have of this rather obscure condition.

Pertinent notes from the literature covered in the appended bibliography will be made, and in addition thereto a series of five cases and two isolated cases not hitherto reported, will be described in some detail. The bibliography has been checked from the indices as follows: Quarterly Cumulative Index, 1928 back to and including 1916; Index Medicus 1926 through 1920; and the comprehensive Surgeon General's Index (covering a period of twenty years) was also checked under the following headings: Bones—Growth, 1922, 1897, and 1881; Clavicle—Abnormalities, 1922, 1898, and 1882; Dysostosis, 1923, 1899, and 1882; and Ossification, 1907 and 1889. There are a few additional references picked from the literature itself.

Abram states that the leading features of the syndrome as reported by Pierre Marie and Sainton are: (1) aplasia, more or less marked, of the clavicles; (2) exaggerated development of the transverse diameter of the cranium; (3) delay in the ossification of the fontanelles; and (4) hereditary transmission.

Abram reports one case, a boy, sixteen years old, four feet and one-half inch in height, weighing sixty-four pounds, definitely a dwarf of the achondroplastic type rather than the diminutive, normally proportioned type. This boy showed (1) complete absence of bony tissue in both clavicles; (2) and (3) a brachycephalic skull, typical except that the palatal arch was not high; (4) there was no evidence whatever that heredity had any part in his malformations. He had a mother, father, three brothers, and one sister all with normal clavicles.

Achondroplastic dwarfs usually show no abnormalities of the clavicles and cranium. This case can fairly be said to fulfil the criteria of Marie and Sainton, with the exception of the hereditary element, and can be classified as a case of cleidocranial dysostosis in a dwarf.

Beer gives a brief description of a boy, eight years old, the only child of normal parents. He believes the deformity of the clavicles to be congenital, but states that rickets at the age of eight months, scarlet fever at the age of two years, and dysentery at the age of six may have contributed to the disorder.

Blencke reports four cases in a family, the mother and three children, all with congenital bilateral defects of the clavicles, hereditary dysostosis.

Carpenter reports a case of absence of the clavicles, with an account of various deformities of the clavicles in five other members of the same family.

Cocker and Sims report a girl, sixteen years old, in whom both clavicles were represented by about one-third of their sternal ends; these could be felt. The free ends moved in the soft parts of the supraclavicular triangle. Her shoulders could be made to touch each other anteriorly. The skull showed prominent frontal and parietal eminences, with the depression between the frontal eminences well marked. There was disturbed and poor dentition.

This case, showing abnormalities of the clavicles, cranium, and dentition, is another case of cleidocranial dysostosis without an hereditary element,—the father, mother, and ten other children showing no abnormalities.

Cyriax reports a case in considerable detail: a woman, thirty-eight years old, gave no hereditary history, her father, mother, and sister being normal. Both clavicles were absent, the right entirely so, though the left showed a piece of cartilage in the position of a normal clavicle. This sternal rudiment was about two inches long, tapering to a rather sharp point. Movement of this fragment caused pain. The shoulders were abnormally mobile. Her face was small in proportion to the skull, forehead low, chin prominent, and the base of the skull was small compared to its width above. The ossification of the skull was incomplete, both fontanelles were open. The suture lines were definitely palpable. The angle of the jaw was very obtuse (about 140 degrees) and the mental suture could be palpated. Second dentition was delayed. All teeth were extracted at age of thirty-five years. The terminal phalanges of the thumbs were unduly pointed, and to a less degree the same was true of the forefingers and little fingers. There was a suggestion of coxa vara. The proximal phalanges of the great toes were longer than usual.

This case, without hereditary history, shows abnormalities of the clavicles, skull, dentition, and in addition, there were other suggestive bony anomalies. It may be classified as cleidocranial dysostosis, without hereditary evidence, and with other bony anomalies.

Evans reports "a case of cleidocranial dysostosis" which can hardly be accepted as such. This was an infant, two weeks old, who showed a large head, the parietal eminences being particularly prominent. Anteriorly there was a wide gap between the frontal bones, as there was also in the position of the coronal suture; the posterior fontanelle extended almost over the back of the head, the ossification of the occipital bone being especially incomplete. The clavicles were normal and there were no other abnormalities,—a case of cranial dysostosis—disturbed ossification of membranous bone.

Fitzwilliams reports one case of "hereditary craniocleidodysostosis" and tabulates fifty-nine others in a very careful summary.

Frank reports a case of "dysostosis cleidocranialis". In Frank's article, he gives a very brief report of a single case of a child, two years old, from a family showing no deformities of any sort. He has no important conclusions.

Garrahan and Schinelly report four cases in one family, including the father. The father's fontanelles had never become normally ossified, his lack of clavicles had never inconvenienced him. One boy of this group gave one positive Wassermann, the others were negative. These authors believe Jansen's theory of causation has real merit.

Gegenbauer, quoted by Yttri, reports a case of a woman with clavicular deformities, which deformities she transmitted to her children by two different husbands.

Greig reports an unmarried woman, forty-seven years old, who had never borne children. The shafts of her clavicles were absent, but the sternal and acromial ends were present. Greig believes this emphasizes what he says Keith has pointed out,—namely, the double origins of the clavicles—the shafts from membrane and the ends from cartilage. Greig erroneously credits Comby with the naming of the syndrome in 1904, and believes the name should be retained. He observes, however, that one congenital defect is frequently associated with other congenital deformities, and states that in the patient he reports there is a left inguinal hernia and a prolapsed uterus probably due to developmental defects. The cranial abnormalities were not very marked, but did show unusual thinness of the cranial vault, a flattening of the vertex, and a distinct median sulcus in the osseous part of the palate, broadening into a navicular fossa occupying the anterior half of the soft palate.

Greig notes that some writers are inclined to reject the name "cleidocranial dysostosis", the condition not being local, but one in which all bones developed from membrane may participate, and probably, at some time or other, do participate.

Hesse reports a case of cleidocranial dysostosis with particular consideration of the teeth. Dentition is frequently disturbed.

Hultkrantz, summarized by Nettesheim, made a collection of sixty-eight cases of cleidocranial dysostosis in 1908. He not only made extensive examinations in living patients, but also on skeletons. According to his investigations, all parts of the cranium participate in the deformity, the most characteristic being the disturbed suture formation in the vault of the cranium. The individual bones may fail to unite and persistence of the fontanelles is the result. By the formation of accessory centers of ossification, a large number of wormian bones appear between the chief cranial bones. As a result of retarded suture formation, depressions and apertures remain in the cranial vault, chiefly in the frontal and sagittal sutures, which may be filled with rigid connective tissue or even with bony substance. At birth all sutures gape widely with the exception of the lower portion of the frontal suture. At the same time, the dimensions of the head are normal. It seems, therefore, a matter, not of mechanical disten-

tion of the sutures due to abnormally large cranial content, but rather of checked growth of the bones of the cranial vault.

The base of the skull is also considerably involved in this disturbance to development. The symphyses at the base of the skull may be incompletely ossified. The base of the skull shows a reduced longitudinal diameter, though it may be slight; this results in more extensive arching of brow and occiput. An important abnormality is the width of the cranial base which is smaller than normal, strikingly apparent in the middle portion. As a result of this, the squamous portions of the temporal bones sit in a diagonal position, so that the mastoid processes are displaced in a medial direction and lie in a deeper location than normally. The enlargement of the transverse diameter of the cranial arch renders the narrowness of the base more distinctly apparent. In the middle region the base of the skull shows an inward depression. The clivus is dented between the sphenoid and occipital portions, and shows an abrupt decline and shortening. The large occipital foramen, whose level is approximately at the middle of the nose, is turned forward more than normally because of the depression in the base of the skull, so that a continuation of the level of the occipital foramen runs through the forehead.

The author points out that the facial skeleton may also be affected; the individual bones are smaller than normal, particularly the nasal and lachrymal bones which are either absent entirely or are only slightly developed. Often the zygomatic bone also shows only slight development and the superior maxilla is very low. The accessory cavities are narrow or practically absent. The palate is usually high and narrow. In every case there is a high-grade disturbance to development of the teeth in the form of retarded breaking through the gums, faulty implantation, or defective coating with enamel. Another pronounced characteristic of cleidocranial dysostosis, in addition to disturbed suture formation in the vault of the cranium, is the disproportion between cerebral and facial skull, involving various types of asymmetry. The skull is usually brachycephalous in form, frontal and parietal eminences being particularly prominent. The occiput in the upper portion may be considerably vaulted or rather flat. The head has a four-cornered or pentagonal shape. In almost every case these abnormalities of the skull are accompanied by unilateral or bilateral malformations of the clavicle. The degree of this latter abnormality varies greatly, ranging in severity from very slight abnormal formation to complete absence. The scapula is usually small and deviates from normal in the development of its processes and fossae. Spinal column, thorax, and pelvis are often deformed. Malformations in the joints of the fingers and genua valga are often observed. Victims of this disease are usually small of stature and of weak build.

Jansen suggests the following theory as to the pathogenesis: It is due to a restriction of the amnion, with consequent pressure of the latter on the embryo, which pressure results in this malformation because of the hypertension of the amniotic liquid, due also to the smallness of the membrane.

These pressures usually occur about the eighth week of pregnancy. If they occur later, achondroplasia or similar affections may result, depending on the stage. Jansen states that (1) large anterior fontanelle, (2) absence of the whole or part of the clavicle, (3) shortening of the toes, and (4) bilateral flattening of the chest are common to all cases of cleidocranial dysostosis.

Klar reports a case complicated by coxa vara.

Krabbe notes metabolic disturbance in a case of cleidocranial dysostosis.

Krebs and Terry report a negress and her new-born child who presented anatomical defects recognizable by superficial examination and by x-ray as characteristic of cleidocranial dysostosis.

La Chapelle reports five cases in one family.

Léri and Trétiakoff analyze the necropsy findings in a typical case, showing evidence of an intra-uterine inflammatory process in the brain and meninges.

McBride reports two cases of congenital defects in the clavicles which give no familial or hereditary history. His first case, a child five years of age, had a prominent forehead, six definite bosses, closed fontanelles with a depressed outline. The teeth were irregular, and the palate had a high arch. X-ray examination showed full length clavicles with a separation in the middle of each.

McBride's second case, a boy nine years of age, had a prominent forehead, two symmetrical frontal bosses with a deep furrow; four other bosses were slightly enlarged. The anterior fontanelle was not entirely closed. The teeth were regular, and the palate was normal. X-ray examination showed a complete absence of both clavicles, except for a rudimentary acromial end on the left.

McCurdy and Baer, in dealing with the historical aspect of cleidocranial dysostosis, state that the first case reported was by Morand in 1766. The second case reported was by Barlow in 1883. In 1905, Villaret and Françoz compiled twenty-eight cases from the literature, and reported a woman and three children. In 1910, Fitzwilliams compiled and analyzed fifty-eight cases and observed two others. Langmead in 1916 reported eighteen cases in four generations and observed seven of these cases.

McCurdy and Baer report nine cases in three generations, a father and four of his daughters being observed by them. They have tabulated the physical findings as observed in their series, and the following summarizes these findings: The stature was generally small. The head was large and brachycephalic, with sutures and fontanelles showing delayed closure. The frontal, parietal, and occipital bosses were more or less prominent, with sulci, corresponding to the cranial sutures, separating the bosses. The bosses and sulci remain through life. The sella turcica and facial bones were normal, the bridge of the nose was sunken. The lower jaw was prognathous. Dentition was late and irregular, and the palate was high arched. Clavicles were defective,—the acromial end was usually absent, the rest of the clavicles was rudimentary or absent. The shoul-

ders assumed the position of bilateral clavicular fracture, and the upper chest, in the adult, was more conical than normal. There was compensatory development of the muscles of the neck and shoulders. The shoulders were extremely mobile. There was no evidence of lues.

Marie and Sainton report four cases. The first a woman with a large head, prominent frontal and parietal bones, grooves along the suture lines, and open fontanelles. The plate was high arched, and her teeth were irregular. Her clavicles were represented by sternal fragments only. She could not hold her arms out straight before her. The second case was a child, daughter of this woman. She had no disability. Her head resembled closely that of her mother. She had no clavicles whatever. Marie's third case was a man. He had a very large head, prominent bosses and sutures, and open fontanelles. He had a narrow cleft palate, and bad, irregular teeth. He had both acromial and both sternal ends of the clavicles; the shafts were defective. He had syringomyelia. The fourth case was a boy, son of this man, who showed all the deformities of the father.

Marie and Sainton note the hereditary character of this malformation, but say it had never been known to run more than two generations, there being a tendency to revert to normal type. They also emphasize what they believed to be the fact,—that these people may develop syringomyelia and hydrocephalus. They noted that all their patients showed signs of rickets

Montanari reports a case of achondroplasia with defective ossification of skull, clavicles, and fingers.

Moreira discusses cleidocranial dysostosis as an hereditary disease, and its connection with other forms of congenital dysostosis.

Mouchet reports a case, patient forty-seven years old, with an anterior fontanelle the size of a "palm of the hand".

Nettesheim has observed carefully and reports a case involving extensive familial occurrence of the deformity. His patient was a woman, twenty-nine years old, who came to his clinic for delivery. Her father was living, in good health, and showed no abnormalities. Her mother was dead, but the patient stated that a physician had noted at one time that her mother had a bilateral defect of the clavicles. The patient also stated that her mother and maternal grandmother showed malformations of the skull. So far as known, all other maternal relatives were normal. The patient had one brother and three sisters; one sister, eighteen years old, and the brother, twenty-two years old, had bilateral defects of the clavicles, and pronounced genua valga. At the age of twenty years, the patient had twenty-four teeth extracted, because they were in very bad condition. Very soon they were replaced by new teeth which were removed by her dentist and artificial teeth were fitted. This woman was tall and slender, with marked genua valga. Head was large, symmetrical, with prominent frontal and parietal protuberances. The cranial vault was flat, with saddle formation in the transverse diameter. A shallow groove extended from about the middle of the brow practically to the middle of the skull; it was widest in the region of the coronary suture (four centimeters). The de-

pression between the frontal protuberances was about three millimeters deep; below this a tense resistance could be palpated, but it was not firm enough to give the impression of being bone. The sagittal suture was closed. She was brachycephalous. She had bilateral deformities of the clavicles. On the right, a sternal portion of the clavicle communicated with the acromial portion by a narrow strand, palpable through the overlying tissues. The left clavicle had a defect in the shaft with motility between the sternal and acromial portions. The x-ray showed that this clavicle had three distinct sections,—a sternal and an acromial end, with a small bone in the intervening space; this bone was about two centimeters long, and appeared to be connected with the acromion, the acromial end not extending quite to the acromion. X-ray of the vault of the cranium showed a saddle formation in the transverse diameter, and very pronounced protrusion of the frontal and occipital bones. In the frontal bone there was a large aperture, beginning in the form of an acute angle only a few centimeters above the root of the nose and growing wider as it extended upward. It reached its maximum width at the level of the coronary suture at which point the aperture terminated in blunt fashion. The suture between the parietal bones was unusually distinct; the same was true in greater or less degree of all the sutures in the cranium. Many minor ossification defects in the sutures were found, particularly in the region of the temporal and occipital sutures. Between the parietal and occipital bones, numerous wormian bones were noted. The frontal sinuses could hardly be recognized. The facial cranium was very small in comparison to the cerebral. The nose which clinically appeared normal was composed almost entirely of a cartilaginous framework, the nasal bone being almost entirely absent. There was general constriction of the pelvis shown by mensuration.

The child, a girl, born to the patient, had defective clavicles,—only sternal portions could be felt. The x-ray showed no trace of clavicles when the child was ten days old. Examination of the skull showed that the frontal bones, particularly in their medial portion, had been retarded in their development, so that the large fontanelle began at a point only a finger-breadth above the root of the nose. Since the parietal bones showed only slight development, having a diagonal diameter of not more than six centimeters, the fontanelle extended over the entire cranial vault and joined with the small one without interruption. Laterally the coronary suture gaped to the extent of two centimeters between the frontal and parietal bones; the temporal suture was also a cleft about two centimeters wide. The narrowest space between the two parietal bones was two and five-tenths centimeters. The lambda suture, in comparison with the slight development of the parietal bones and the occiput, was very wide.

The brother of the patient was a tall, slender man who showed cleidocranial dysostosis. The right clavicle had sternal and acromial ends; the left clavicle consisted of one large bone which ended about two centimeters from the acromion. There was a narrow spicule of bone extending from

the acromion on the left, but not reaching the large sternal shaft. This man had had a marked genua valga corrected by osteotomy when seventeen years old. His face was slightly asymmetrical, larger on the right, with the nose deviated to the left. The frontal and parietal bosses were prominent. The cranial vault was rather flat, dropping almost perpendicularly at the back. Lower jaw was somewhat larger than the upper; the palate was high and narrow. There was very poor and defective dentition.

Nettesheim has therefore examined two generations in a family showing cleidocranial dysostosis extending, by fairly reliable report, through four successive generations.

Nettesheim notes that this syndrome should have special interest for the obstetrician because of complications in diagnosis and technique of delivery from point of view of both mother and child.

Paltauf demonstrates the skeleton in a case of cleidocranial dysostosis in detail, showing the abnormalities of this affection. He agrees with Hultkrantz in assuming that the cause of this malformation lies in a primary change in the parental germ plasma.

Pillsbury considers a single case of dystrophy of the clavicles and skull which, in addition, showed changes in the fifth right metatarsal, and bilaterally in the first and second metacarpals. There was partial failure of the thyroid. This patient's father, mother, and sister were normal.

Poynton reports a case of cleidocranial dysostosis in which there were severe shooting pains down inner side of right arm and over the chest, marked loss of power in the right hand, and much circulatory disturbance. When the right shoulder was depressed, the right pulse was diminished in volume, a sign which assisted in the exclusion of syringomyelia, a condition which has been described in association with this form of dysostosis. The outer fragment of the right clavicle, which had been pressing on the right brachial plexus, was removed. Patient was completely relieved of the severe neuralgic pains, her hand recovered its power, and she was able to resume her occupation as dressmaker. In this case the fontanelles had not closed until she was seventeen years old. The teeth of the upper jaw were irregular and poorly formed. The clavicular defect in the shaft was bilateral.

Raubitschek reports autopsy findings in the case of a woman, fifty-five years old, who died of chronic nephritis. There were no defects in the clavicles. The skull findings were typical of cleidocranial dysostosis, but there were other bony changes which would make this a case of generalized osseous malformation, or at least a very atypical form of cleidocranial dysostosis. His conclusions agree essentially with those of Hultkrantz noted above.

Shattock examined a girl, six years and eight months old, without familial or hereditary history of abnormalities. She had Mongoloid facies, coarse, dry hair, but good mentality. Her palate was high arched. There was a history of delayed closure of the fontanelles, but they were closed on examination. X-ray examination showed thinning of bone in region of

bregma; stunted development of nasal bones; and an absence of the frontal sinus. The clavicle on the right showed an absence of bone in the middle third, and imperfect ossification on the left. The toes showed an absence of the epiphyseal centers in the phalanges; abnormal breadth of the phalanges of the hallux; and poorly developed ungual phalanges. The fingers showed irregular epiphyseal lines in some of the intermediate and terminal phalanges; proximal and distal epiphyseal centers in the second and fifth metacarpals; and poorly developed ungual phalanges.

Sherman reports two cases. The first was a boy, three years old, with marked evidence of rickets. Both fontanelles and the frontal suture were widely open. There was no hydrocephalus. The frontal bones were very prominent. There was no ossification of either clavicle, although a rudimentary clavicle could be palpated on the left, and a sternal end could be palpated on the right. There was some deformity of the scapulae, the spinous processes seemed to be too high on the bodies, and not as prominent as they should be. Function of the shoulders was practically perfect. The father and mother were normal.

Sherman's second case was a girl, seven years old, who also had marked rickets. Clinically and by x-ray there was no evidence of clavicles. The sternum was much depressed. The fontanelles and sutures were closed, but there were well marked depressions along the suture lines, including the frontal suture. The head was large with prominent frontal and parietal bosses. The bridge of the nose was not sunken Shoulder motions were free and painless. The mother was normal. The father showed evidence of overlapping and imperfect union of what was believed to have been bilateral fractures of the clavicles. His head was large and square, with flattening of the top.

Spriggs reports a girl, twelve and a half years old. The fontanelles were closed, the head was globular in shape, the palate was high arched, and the dentition was irregular. The clavicles showed a division into two halves, with what appeared to be a loose joint between the halves. There was no hereditary element, but Spriggs notes that this child's mother suffered from myxoedema two years after the birth of the patient, and states that this is the third case in which he has seen developmental defects in the child of a myxoedematous mother.

This author states that Scheuthauer noticed the association between the deformity of the clavicles and cranium in 1871; that Walsham, Gross, Schorstein, George Carpenter, Preleitner, and several others have observed defects in clavicles with absent or rudimentary inner or outer portions, or both. Familial relationship was noted by some as in Preleitner's cases of brother and sister.

Stern reports a case of a boy, six years old, who showed a congenital absence of both clavicles, except for rudimentary sternal ends. He noted no other abnormality. There was no interference with function. The father, three paternal uncles, and two brothers of this boy are said to have

had no clavicles, while a paternal aunt and three sisters were normal. The case reported is the only one actually observed by Stern.

Terry reports a case of rudimentary clavicular deformities and other abnormalities of the skeleton of a white woman.

Villaret and Françoz have published a very good summary of twenty-eight recorded cases, with some good photographs.

Voisin, Voisin, and de Lepinay report a case of cleidocranial dysostosis and give a bibliography to twenty-eight previous cases.

Yttri reports a case of malformation of clavicles and skull, and has compiled notes from considerable literature. He notes a tendency to deformities through two or three generations. He believes there may be malformation of the skull alone, of the clavicles alone, or as is usual, both may be defective. Puberty, he notes, is late, but not impaired. He stresses the mutation type of anomalies, where there is a spontaneous appearance of a characteristic, its transmission to offspring, and its disappearance by cross-breeding. He states that there were seventy recorded cases: twenty in Germany and Austria, fifteen in France, nine in Sweden, and six in North America, the others scattered.

Zilkens reports dental findings in two cases. The first a girl, eighteen years old, with some teeth absent, others present, but unable to force their way through the gums. One brother and one sister of this girl showed the same anomaly besides congenital deformity of the shoulder blades. Another sister, seemingly normal, gave birth in the previous year to a child showing anomalies of the clavicle. The mother died of tuberculosis at the age of fifty-seven and is said to have worn artificial teeth from a very early age.

The second case Zilkens reports was a boy, seventeen years old, who showed a retention of teeth. Zilkens assumes that this is a case of cleidocranial dysostosis because of the form and size of the lower jaw and size of face in comparison to the skull. The family history was not available. This boy had rickets as a child which may have had some influence on the findings, but the author believes it to be a case of congenital cleidocranial dysostosis.

Krabbe, as mentioned above, reports a well defined case of cleidocranial dysostosis without an hereditary history. This case was a man, twenty-eight years old, with a definite mental disturbance with hallucinations and persecutory ideas. His skull was markedly brachycephalic. There were defective fontanelles and suture lines. The nasal bone was not at all ossified. The lateral halves of the clavicles were not ossified. There was no spina bifida. There was marked coxa vara on both sides.

The basal metabolic process was increased thirty-seven per cent. at one examination and thirty per cent. on another examination.

This case of Krabbe's is undoubtedly a case of cleidocranial dysostosis without a familial or hereditary history, but in addition to the classical deformities he has noted undoubted bilateral coxa vara and an increase in the metabolism on two occasions, taken by a careful observer. He states

that complications with coxa vara have been substantiated in one clinical case, described by Klar, in 1906, without any description of the symptoms. He believes there is some uncertainty about Paltauf's observation of a case with coxa vara, because the same case was described clinically by Fuchs in 1907, without indicating the diagnosis of coxa vara. He hesitates, and rightly, to accept Raubitschek's case as a typical cleidocranial dysostosis.

In 1899, two years after Marie reported his cases, Alfred King, Surgeon to the Maine General Hospital, reported a case of "congenital malformations of the clavicle in two children simulating an accidental condition in the mother".

Quoting freely from his report:

"Mrs. C., forty-one years old, of slight build, the wife of a clergyman, stated that when she was nine years old, she fell and fractured her right clavicle, which at the time of writing showed non-union, having been neglected. The sternal fragment measured two inches. When extended both fragments together measured four and one-half inches, exactly the same as the sound clavicle. When the shoulder was drawn in, there was shortening of three-fourths of an inch. The ends, at the site of non-union, were slightly enlarged, especially on the sternal fragment.

"Mrs. C. had had three children. The first one died when fifteen months old. Nothing certain is known as to the condition of the clavicles, but no attention had ever been given or called to them.

"The second child, Jennie, is now fifteen years old. When several months old, her nurse accidentally discovered trouble with the right clavicle. She had never met with an accident and nothing had ever attracted attention to it. At the time this was discovered, there was no soreness and no inconvenience, nor had there ever been. Examination showed an apparently ununited fracture of the right clavicle. The sternal part was exactly two inches long. When both fragments were in line, they measured four inches, while the left clavicle measured four and one-half inches. The ends about the apparent fracture were enlarged, especially the sternal one.

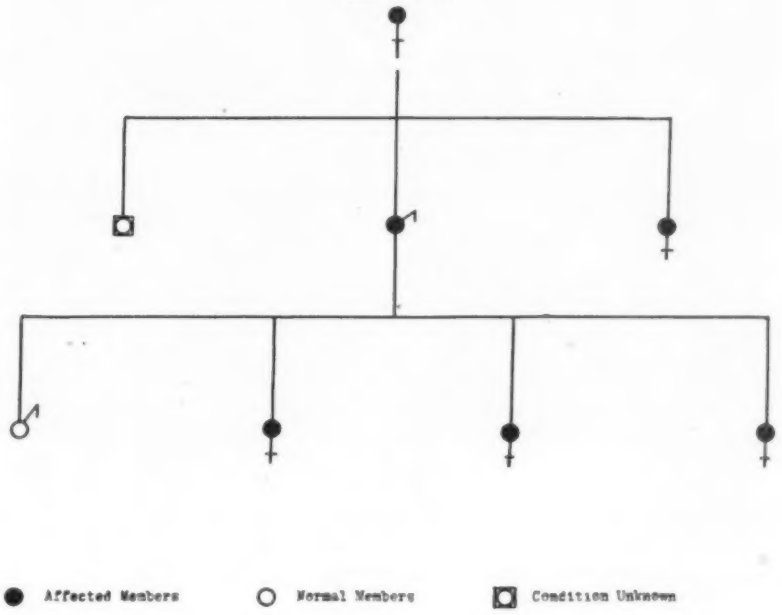
"The third child, Paul, is now a boy of eight years. He had the same history as his sister, Jennie. A few weeks after birth, the nurse accidentally discovered that there was trouble with his right clavicle. Examination showed an apparently ununited fracture of the right clavicle. The sternal fragment measured two inches; when extended the clavicle measured four inches, the same length as the left clavicle. The sternal end was more clubbed than the acromial end at the site of the apparent non-union.

"The mother stated that she had not met with any accident or injury during her pregnancies; that she had never thought about the possibility of a child inheriting such a condition; that when Paul was born she had not even thought to examine his clavicles. The children were born at normal labors, head presenting, and weighed about seven pounds. The doctor who attended Mrs. C. at her second labor was dead, but the doctor who attended her at her third labor was alive and stated that there was nothing unusual about the labor, and that he had not known that there was any clavicular deformity."

Dr. King then sums up as follows: "We have a mother, who has an ununited fracture of her right clavicle, caused by an accident in childhood. She has two living children, born after normal pregnancies, of natural size, in natural labor, who have never had any accidents, and who have, apparently, ununited fractures of the clavicle on the same side in the same place, and with the same clubbing of the sternal end as their mother."

The writer has seen these three patients mentioned by Dr. King. His recorded findings are accurate.

CHART 1.



Mrs. C. died a short time ago. Unfortunately no x-ray examination was ever made, and no clinical findings accurately noted, other than those made by Dr. King, are available.

Jennie, now forty-six years old, single, is living and well. Paul, now thirty-eight years old, is living and well, and the father of four children. Jennie, Paul, and the four

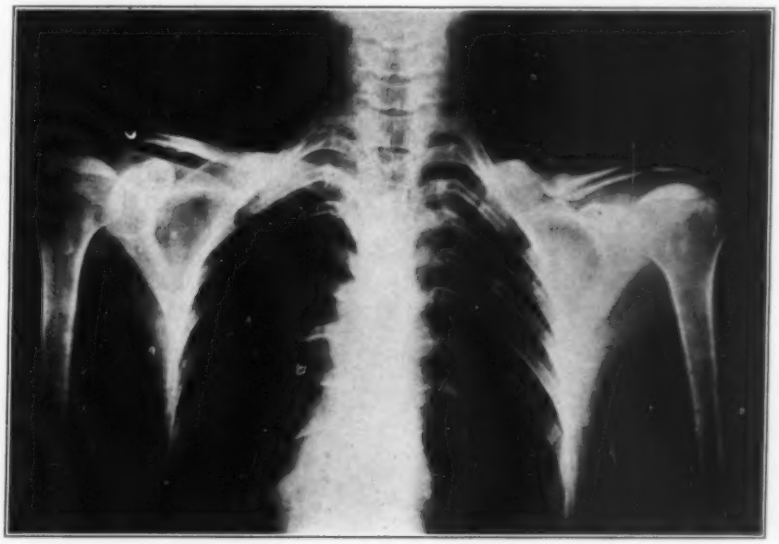


FIG. 1

Jennie. Defect of the shaft of the right clavicle.

FIG. 2
Paul. Defect of the shaft of the right clavicle.

children, Jack, Nancy, Ruth, and Betsy, have been carefully studied from the x-ray and clinical points of view (Chart 1).

Jennie is moderately dolichocephalic clinically and by x-ray. The sutures, fontanelles, and bosses are within normal limits. The palate is not abnormally high. There is a definite defect in the shaft of the right clavicle, with no marked tendency to clubbing of either fragment. There is moderate asymmetry of the chest, the right side being more conical than the left. There is a slight scoliosis with the convexity to the right (Fig. 1).

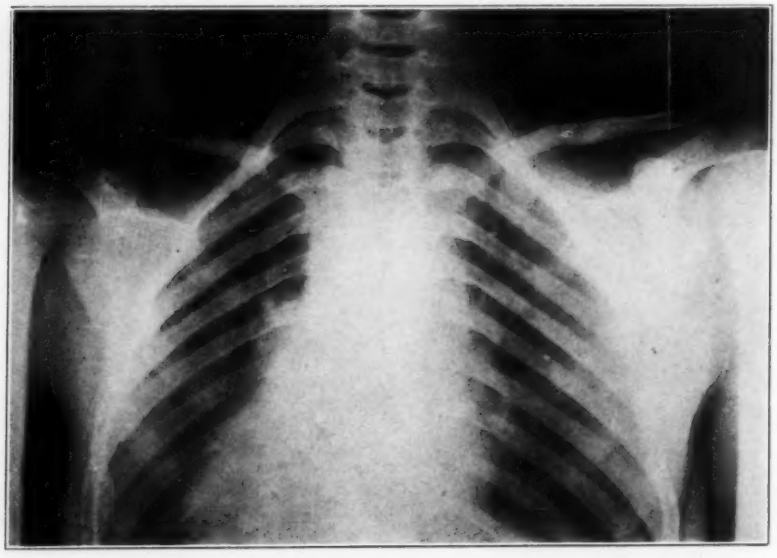


FIG. 3
Jack. Normal clavicles.

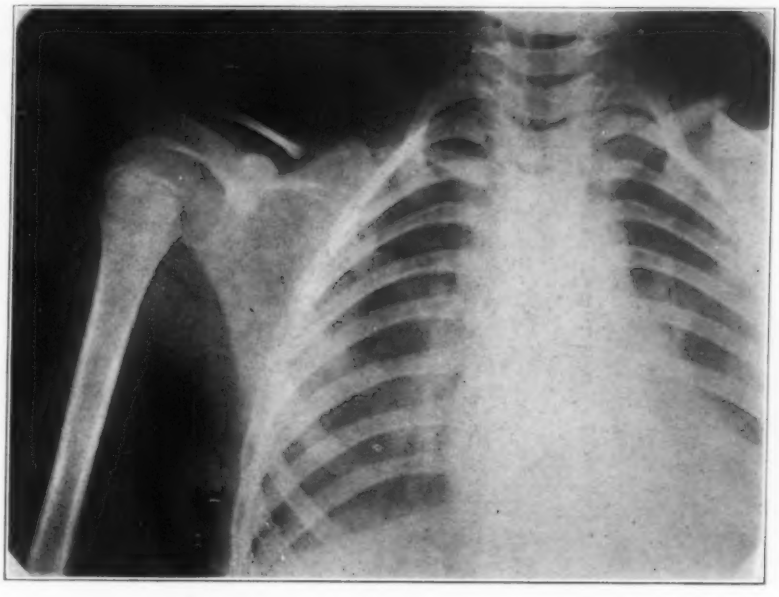


FIG. 4
Nancy. Defects of shaft of both clavicles.

Paul is a tall, slender man, thirty-eight years old. He was active in school and college athletics, and has never had any inconvenience from his defective clavicle. Skull is well formed, with four bosses which might be termed slightly prominent, but certainly not abnormal. Sutures and fontanelles are normal. The nasal bone is rudimentary. The palate is not abnormally high. There is a defect in the shaft of the right clavicle, with tendency to clubbing on the acromial fragment. The chest is slightly asymmetrical, but only slightly so. The shoulders are squared, and carried normally (Fig. 2).

Jack, twelve and one-half years old, shows no bony abnormality except four slightly prominent bosses and a prominent occipital protuberance. There is a history of delayed dentition, first teeth appearing at about nine months (Fig. 3).

Nancy, a normally formed girl, ten and one-half years old, of average height, has four slightly prominent bosses. Sutures and fontanelles are closed. Palate is within normal limits. First teeth at about nine months; present teeth are poor. There is a defect in the shaft of each clavicle, the acromial end of one is rudimentary. There is no marked clubbing or sharpening of the fragment ends. The chest is symmetrical. The shoulders are squared and held normally. There is a defect in the lamina of the first sacral vertebra (Fig. 4).

Ruth, like her sister, is a normally formed child of eight and one-half years, of average height. There are four slightly prominent bosses. The sutures and fontanelles are closed. Palate is normal. First teeth at eight months. Has recently received school prize for condition of her teeth. There is a defect in the shaft of each clavicle; one clavicle is more rudimentary than the other. The chest is symmetrical and the ribs are normal. Shoulders are held squarely (Fig. 5).

Betsy is a well formed infant of two years. The cranium is normally formed. The coronal suture is rather prominent. The anterior fontanelle is open about one inch. There is no ossification in the nasal bone. There is a tendency to a prognathous jaw. The first teeth were noted at about six months. The palate is normal. There is a bilateral defect in the shafts of the clavicles. The chest is symmetrical. There is

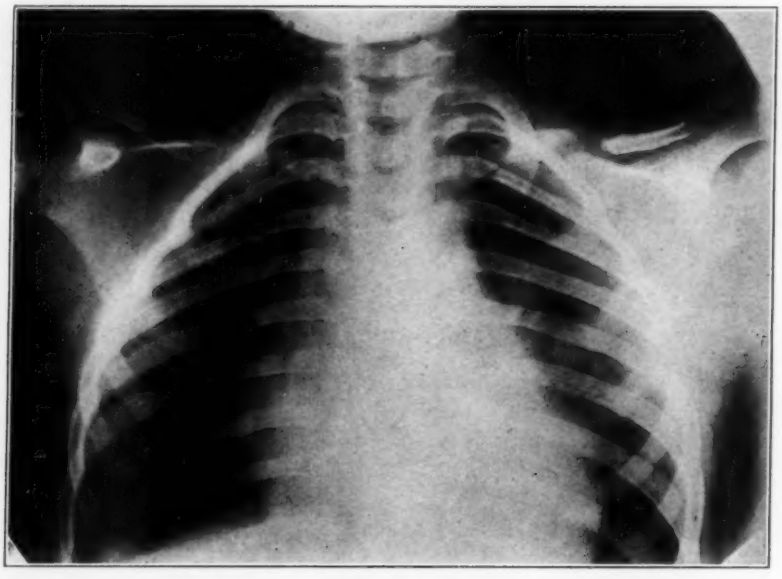


FIG. 5
Ruth. Defects in both clavicles.

evidence in the long bones of slight rickets. There is a defect in the lamina of the first sacral vertebra. The thumbs and great toe show a rather large epiphysis at the proximal ends of the distal phalanges (Fig. 6).

The x-ray findings are summarized in the accompanying chart (Chart 2).

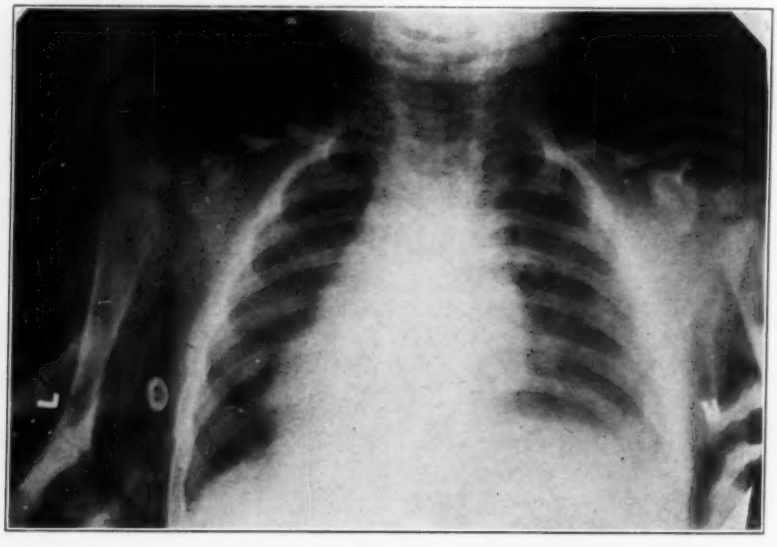


FIG. 6
Betsy. Defects in both clavicles.

CHART 2.

SUMMARY OF X-RAY FINDINGS

	Jennie	Paul	Jack	Nancy	Ruth	Betsy'
Skull						
Shape	Slight doli-chocephalus	Normal	Normal	Normal	Normal	Normal
Sutures	Closed	Closed	Closed	Closed	Closed	Prom. coronal suture
Fontanelles	Closed	Closed	Closed	Closed	Closed	Ant. open 1"
Bosses	Normal	Normal	Normal	Normal	Normal	Normal
Nasal bone	Normal	Rudiment	Normal	Normal	Normal	No ossific.
Sella	Normal	Normal	Normal	Normal	Normal	Normal
Mastoids	Normal	Normal	Normal	Normal	Normal	
Teeth	Normal	Normal	Normal	Normal	Normal	Normal
Prog. jaw	No	No	No	No	No	Tendency
Sinuses	Normal	Normal	Normal	Normal	Normal	
Clavicles, Defects in	Mid shaft, rt. ℰ. blunt ends	Mid shaft rt. ℰ. club acr. end	Normal	Bilat. mid. shaft	Bilat. mid. shaft	Ends normal. Bil. defects shafts
Chest	Asym.	Asym.	Sym.	Sym.	Sym.	Sym.
Ribs	Conical on rt. Ribs normal	Normal	Normal	Normal	Normal	Normal
Sternum	Normal	Normal	Normal	Normal	Normal	Normal
Arms						
Humerus	Normal	Normal	Normal	Normal	Normal	Normal
Radius & ulna	Normal	Normal	Normal	Normal	Normal	Normal Sl. rickets
Hand & wrists	Normal	Normal	Normal	Normal	Normal	Large epiphy. prox. end distal phal. thumbs
Spine	Sl. scoliosis Convex. to rt.	Normal	Normal	Def. lam. 1st sac. v.	Normal	1st sac. vert. lam. not closed
Pelvis	Normal	Normal	Normal	Normal	Normal	Normal
Coxa vara	No	No	No	No	No	No
Legs						
Femora	Normal	Normal	Normal	Normal	Normal	Normal
Tibia & fibula	Normal	Normal	Normal	Normal	Normal	Normal
Ankles & feet	Normal	Normal	Normal	Normal	Normal	Large epiphy. prox. end distal phal. gt. toes

The basal metabolism of Nancy and Ruth was carefully checked by Dr. Fritz B. Talbot, who states that in both cases the basal metabolism was within normal limits. This finding is also in accord with Dr. Talbot's study of the basal metabolism in several cases of achondroplasia (not yet published) in which the basal metabolism was found to be within normal limits.

Dr. Talbot also checked the blood calcium and the blood phosphorus in these two children, and found them to be within normal limits.

There can be not the slightest doubt that Mrs. C., Jennie, Paul, Nancy,

Ruth, and Betsy are definite cases of hereditary, familial cleidocranial dysostosis, six cases observed through three generations.

This family, while tending to be the tall, thin type, is not abnormal in stature, there certainly being no suggestion whatever of the achondroplastic. The shape of the head does not justify classifying them as brachycephalic (careful mensuration was not done), one member being definitely dolichocephalic. The fontanelles, sutures, and bosses, except in the infant, do not greatly vary from the normal as seen constantly in a children's clinic. There is a spina bifida occulta in two of this group—this is too frequent a finding to be of any significance, particularly above the level of the pelvis. The asymmetry of the chest is merely a concomitant of the clavicular dysostosis.

FIG. 7

Adeline. Acromial ends of both clavicles are missing. Scoliosis, and defects in numerous vertebrae.

Through the kindness of Dr. A. H. Brewster, of Boston, the author has examined the record and x-rays of one of his patients:

Adeline was a child whom Dr. Brewster was treating for extreme scoliosis. Her anterior fontanelle was not closed at seven years of age. She was moderately brachycephalic. There were eleven ribs on the right and eleven on the left. There was no evidence of ribs opposite the twelfth dorsal vertebra, assuming this vertebra is the twelfth dorsal. If it should be considered the first lumbar, she would then have six lumbar vertebrae. The seventh to eleventh dorsal vertebrae had bifid bodies. The fourth and fifth lumbar and all sacral vertebrae have defective laminae. There was moderate genua valga, and old rickets. Her Wassermann blood test was negative. The acromial ends of both clavicles were absent. The father and mother are said to be normal (Fig. 7).

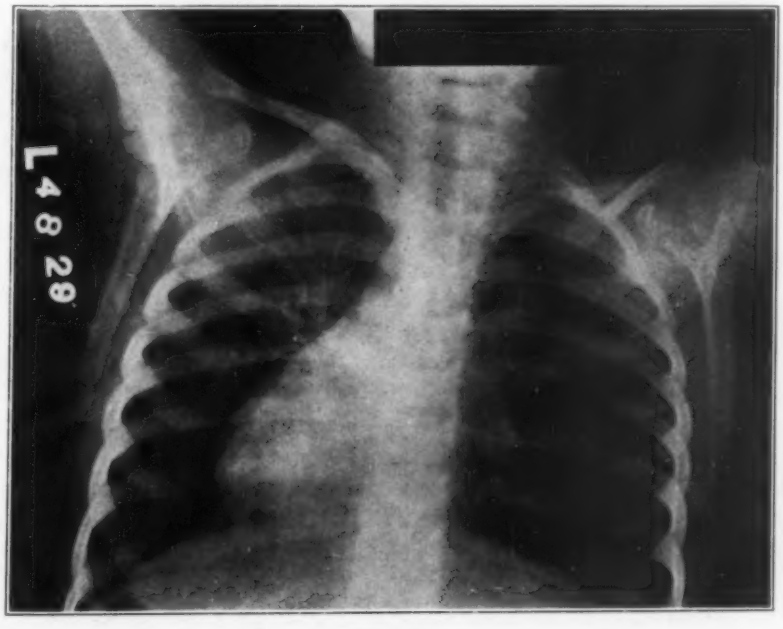


FIG. 8

Gofreda. Defect in the shaft of the right clavicle.

Gofreda is a boy six and one-half years old, whom the writer saw in consultation at the Children's Hospital, Boston. He was in the hospital for meningococcus meningitis. The family history was unimportant; no defects were recorded. He was a normally developed Italian boy, breast-fed for thirteen months. He walked at sixteen months. There is a history of bed-wetting and frequent wetting of his clothes.

His head was normally shaped, forty-nine centimeters. Teeth were good. The chest was well developed; there was no Harrison's groove. Blood calcium was 10.1 milligrams per hundred cubic centimeters. Blood phosphorus was 4.4 milligrams per hundred cubic centimeters. There was a history of a swollen, tender "right shoulder" of three weeks' duration when thirteen months old, following slight trauma.

Complete x-ray studies were made. The head, spine, thorax, pelvis, and extremities were normal. There was a defect in the shaft of the right clavicle, with no evidence of callous formation. The sternal end tended to be the vertical type (Fig. 8).

The history of disability at thirteen months casts some doubt on the diagnosis, but the appearance of the clavicular fragments and the clinical findings are consistent with the diagnosis of congenital cleidal dysostosis.

There are many malformations that have been noted to accompany the defective clavicles. Some of those reported are brachycephalic and dolichocephalic skulls, malformations of the various sutures, fontanelles, and bones of the skull and face, disturbed dentition, achondroplasia, variations in the small bones of the hands and feet, deformities of the thorax, spine, and pelvis, prolapse of the uterus in a virgin, inguinal hernia, and spina bifida. There are, of course, the anomalous muscle and tendon attachments, concomitant with defects in the clavicle.

The clavicular deformities are always accompanied by more or less variation in muscles. The clavicular portion of the trapezius may be present or absent, there may be maldevelopment of the pectoralis major, the clavicular portion of the deltoid may be deficient, or there may be a wide variation in the form of the sternocleidomastoid.

In spite of the frequent involvement of the sternocleidomastoid muscles, in some cases it being entirely absent, no case of torticollis was found in the literature and none exist in this series.

Heineke distinguishes between types of congenital kinking or separation with a pseudarthrotic gap between the fragments filled with connective tissue; or a partial defect of one, and usually the acromial end substituted or not by fibrous bands; or, finally, total defects of the clavicle.

Cases where there are no clavicles and no scapulae should be in the class of true aplasias rather than in the class of dysostotics.

It is curious how many of the more frequent abnormalities noted in connection with defective clavicles are also noted in connection with more or less advanced rickets—the prominent bosses, delayed closure of sutures and fontanelles for example, and possibly the poor dentition. These, it will be noted, are two of the criteria for the diagnosis of cleidocranial dysostosis.

It is also curious how a deformity may be related with other congenital defects, single or multiple, of no apparent association, such as defective clavicles and a prolapsed uterus, for example.

The clavicle is said to have a double origin, the shaft from membrane and the ends from cartilage, and this seems to be the accepted theory. The flat bones of the skull and face bones have their origin in membrane bone.

Greig and others have noted that in these clavicular defects only the shaft, the membranous bone, is involved. He notes that it is true that the bones of the cranium, the membranous bones, may not, in adult life, present any abnormality, but he feels that the condition is not local, but is rather one in which all bones developed in membrane may participate, and probably, at some time or other, do participate. On this basis he believes, as do others, that the name cleidocranial dysostosis should be retained.

Greig, of course, is in error. There are cases of complete absence of

the clavicle,—both membranous portions and cartilaginous portions, as noted by Hultkrantz and others.

If we accept the idea that the cranial aspect of this syndrome is really rickets, must we also accept the idea that the clavicular deformity is due to rickets? Not at all. The shaft of the clavicle commences to ossify before any other bone of the body—as early as the fifth or sixth week of foetal life—and is well formed at birth. It is difficult to believe that a rudimentary clavicle, sometimes merely a fibrous cord, or a defect in the mid-shaft could in any way be caused by rickets.

Cases of partial or complete absence of the radius, ulna, and fibula have been recorded, as have anomalies of nearly every bone of the skeleton (Cunningham), and such congenital failures of development may be and often are accompanied by defects dispersed throughout the organism.

Nothing whatever is known of the etiology of this condition of the clavicles.

Jansen's theory quoted above and endorsed by Garrahan and Schinelly is totally inadequate to explain the pathogenesis of this malformation.

Experimentally it has been noted that sex may be determined by varying the metabolic rate. Krabbe has noted an increased metabolic rate in an individual with defective clavicles. Perhaps the explanation for congenital anomalies may some day be explained on the basis of variations in the metabolism of the individual, but it will be just as difficult to explain that variation as it is to explain the variations in the clavicles.

Hugo de Vries in his experimental work on plants, while not giving a full explanation of the etiology of these anomalies, has demonstrated that characteristics appear spontaneously and are transmitted to offspring, and disappear by cross-breeding. This, in brief, is all that is known about the various anomalies met with in the human skeleton. The defective clavicles appear spontaneously, probably not as an ununited fracture as noted by King, can be transmitted through at least three generations, and will probably disappear eventually from that family.

If the deformities of the skull must be considered an accompaniment of clavicular dysostosis, then a differential diagnosis should be considered to distinguish carefully between cretinism, achondrodystrophy, osteogenesis imperfecta and Wieland's soft or lacunar skull. There should be no real difficulty,—the clavicular dysostosis is not common to these other conditions.

Sex frequency is about equal. It may be transmitted by either father or mother to either sons or daughters. There are several cases reported which have no familial or hereditary history whatever. Lues plays no known part in cause or transmission of the condition.

It may be placed in the class of systemic intrinsic deformities, the cause of which lies in early developmental aberration reaching back into the first weeks of embryonal life (Steindler).

The question of treatment, if any, should be considered. In one case noted above, there was disability due to pain from pressure of one of the

ends. The obvious treatment is the removal of the part causing the pressure as was done successfully in this case. As a rule, there is little or no disability and usually no discomfort. The abnormal mobility, allowing the shoulders to be brought together under the chin, is in no way a hindrance. However, when the shoulders are thrown back either the acromial or sternal end may be unduly prominent, and in women particularly, may be objectionable from an aesthetic point of view.

While the writer knows of no case that has been operated on, he has found, on the cadaver, that both an acromial fragment and a sternal fragment can be anchored fairly satisfactorily by a strip of fascia lata threaded through a drill hole of the clavicular fragment at fault, carried through the muscles, and firmly attached to the first or second rib. If both fragments should be unduly prominent when the shoulders are back, a piece of fascia lata from one fragment to the other fragment, directly, or with the middle of the fascia anchored into muscle, fascia, or rib should suffice. Bone grafting or transplant will prove the least satisfactory remedy.

There is a medicolegal aspect which should be considered. At least three of the cases observed by the writer have been reported, by thoroughly trained and competent roentgenologists, as "ununited fractures of the clavicle". An unverified story states that a man in England has capitalized his deformity and makes a very comfortable living by occasionally allowing his shoulder to be caught in the closing door of a public conveyance, and then, with convincing x-ray evidence, collecting for his supposed injury. This phase is at least worth remembering in these days of large damage and "malpractice" suits, particularly in view of the difficulty of making an x-ray diagnosis.

From the literature, and from the evidence from the additional cases reported here, it can be stated that this condition, or syndrome, mentioned as early as 1766, and described and named by Marie and Sainton in 1897, and since then known as hereditary cleidocranial dysostosis, is, primarily, a defect in one or both clavicles. There may be an absence of a part or the whole of the clavicle. There may or may not be an hereditary history. There may be marked, slight, or no abnormalities of the bones of the face and skull. There may or may not be disturbed dentition. There may or may not be other related or unrelated anomalies. The abnormalities of the skull and face, when they occur, may not be incompatible with rickets.

It is evident that there are two distinct classes or types of cleidal dysostosis. In one group may be placed those which show a familial, hereditary deformity of the clavicles, with or without other anomalies. In the second group are those cases which show a non-hereditary, non-familial, congenital deformity of the clavicles or clavicle, with or without other anomalies.

With these groupings in mind, it will be seen that there are probably less than a dozen reported families which can be identified as hereditary defects,—defects transmitted to an offspring. And there is a still smaller group that fulfil the criteria of Marie and Sainton.

Fitzwilliams in a very excellent discussion of the whole subject has

given a great deal of attention to the possible explanation of the etiology of cleidal dysostosis and emphasizes the fact that it is bone which is formed in membrane that is involved. It is true, as he points out, that many of the defects are in bone formed in membrane, but it is also true that there are bony anomalies which involve cartilage bone as well.

He states that he was unable to find an instance of transmission through more than two generations, yet he feels that the condition is well named, and that the designation hereditary cleidocranial dysostosis should be retained, citing, for instance, that in his summary, no less than thirty-one individuals were in eight families, and that forty of the sixty cases he discusses are reported to show some anomalies of the skull.

It would simplify much of the mass of contradictory evidence if (always remembering the relationship between one congenital deformity and other congenital anomalies, single or multiple, related or unrelated) the designation "hereditary cleidocranial dysostosis" were discontinued, and the condition recognized for what it is, a congenital cleidal dysostosis, either hereditary or non-hereditary, with or without other anomalies.

NOTE: Complete x-ray studies were made of Jennie through the courtesy of Dr. George A. MacIver, Superintendent of the City Hospital, Worcester. Complete x-ray studies of Paul, Jack, Nancy, and Ruth were made by Dr. Harry F. Friedman of Boston. Complete x-ray studies of Betsy and Gofreda were made by Dr. E. C. Vogt, Roentgenologist of the Childrens' Hospital, Boston. The summary of x-ray findings was rechecked by Dr. E. C. Vogt.

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Male 16, height 4 ft. ½ in., lordosis and scoliosis, slight genu valgum, terminal phalanges of fingers and toes rudimentary, abnormal sternum, coxa vara; sexual development retarded, but intelligence good; clavicles consisted of small rudiments of sternal ends, left being larger and more mobile, both attached by strong fascia to coracoid processes; subclavius muscle absent, others arising from fibrous band; head brachycephalic, fontanelles persistent, extending almost to nasion and forming crucial groove; nasal bones and mastoid processes deficient; maxillae small, palate narrow, high arched, mandible feeble; teeth poor. Mother aged 17 at his birth; father, three brothers, and sister normal.

APERT, E.: Quelques Remarques sur l'Achondroplasie. Nouv. Iconog. de la Salpêtrière, XIV, 290, 1901.
Author draws a parallel between achondroplasia and cleidocranial dysostosis, as affections of cartilaginous and membranous bone formation respectively.

BARLOW: Congenital Absence of Both Clavicles and Malformation of Cranium. British Med. J., I, 909, 1883.
Female, 2, congenital syphilis; clavicles completely absent; acromion and scapular spines prominent, scapulae bent, mobility of shoulders abnormal; large anterior fontanelle and long median gap between cranial bones from 1½ inches above nasion to occiput; palate normal.

BEER, S.: Dysostosis cleidocranialis. Wiener med. Wchnschr., LXX, 699, 1920.
Male, 8, rachitic, small, anterior fontanelle closed at 6 years, broad cranium, high forehead, eyes Mongoloid, frontal suture irregular and partly open; clavicles divided, sternal fragments overriding acromial portions; parents normal.

BENOIT, C.: A Propos d'un Cas de Dysostose cleido-crânienne héréditaire. Berne, 1921.

BLENCKE, H.: Über die angeborenen Schlüsselbeindefekte. Arch. f. Orthop. u. Unfall-Chir., XX, 534, 1922.

BOLAND, M.: A Case of Rudimentary Clavicles. J. Am. Med. Assn., LVIII, 1442, 1912.
Male, 22, height 173 cm., clavicles only 3 inches long attached to sternum with free outer ends, palate V-shaped, head not mentioned; parents and nine brothers and sisters not known to be abnormal.

BRINDEAU, A.: Deux Cas de Dysostose cleido-crânienne congénitale (Two cases of Congenital Cleidocranial Dystrophy). Bruxelles-méd., VII, 1225, 1927.

VAN DEN BUSSCHE, D.: Über einen Fall von beiderseitigem gänzlichen Mangel des Corpus und der Pars acromialis Claviculae. Inaug.-Diss. Amsterdam. H. Delsman, 20, 1890.
Male 30, with rachitic history, dorsal lordosis, lumbar kyphosis and scoliosis, double subluxation of heads of radii and poor development of heads of humeri; clavicles consisting of sternal fragments 3–5 cm. long, mobile, without obvious attachment to scapulae; scapulae "winged"; subclavius muscles absent, trapezius and deltoid inserted into coracoid processes; head anomalies not described but photo shows strong frontal region with median furrow, short face, broad root of nose, flat cheeks. Sister had similar appearance but normal clavicles, as also her 3 children.

CARPENTER, G.: A Case of Absence of the Clavicles. Lancet, I, 13, 1899.
First three generations described by Carpenter in 1899, and fourth generation by Langmead in 1916. There are a few discrepancies between the accounts.

COCKER, A. B. and SIMS, H. S.: A Case of Cranio-Cleido Dysostosis. Lancet, I, 595, 1923.

COUVELAIRE, A.: La Dysostose Cleidocrânienne héréditaire. J. de Physiol. et de Pathol. gén., I, 842, 1899.
A good account of the anomaly; review of the literature, collecting 31 cases, with brief abstracts of those having hereditary history.

COUVELAIRE, A.: Exposé des Travaux. Paris, Steinheil, éditeur, 50, 1904.
Mentions hereditary case: I. 1, said to be healthy and well formed. I. 2, deceased, cause unknown. II. 2, aged 23, poorly nourished, 8 months pregnant; forehead protruding with large eminences separated by median furrow starting 3 cm. above nasion, increasing to 1 cm. deep and 2 cm. broad and ending in a quadrangular depression at bregma; parietals welded together without definite suture, anterior angles elevated above frontals; palatine vault hollow; mandible prominent; clavicles consisted only of small fragments, mobile, articulating with sternum and ending in free points unattached to acromia; sternomastoid muscles inserted into fragments; shoulders could be approximated in front; spinal lumbar curvature, generally contracted pelvis and double genu valgum. Second child showed at 10 months hydrocephalus with widely open sutures and fontanelles; clavicles absent.

CROUZON ET BOUTTIER: Sur une Forme particulière, de la Dysostosis cleidocrânienne de Pierre Marie et Sainton (forme cleido-cranio-pelvienne). Bull. et mém. Soc. med. d. Hôp. de Paris, XLV, 972 and 1099, 1921.

CUTTER, E.: Descriptive Catalogue of the Warren Anatomical Museum. (J. B. S. Jackson) Boston, 21, No. 217, 1870.
I. 1, was thought by his son to have had same defect as himself on account of his sloping shoulders. II. 1 and 2, two of II. 3's brothers, were said by him to have same malformation as himself. II. 3, had both clavicles divided into small fragments attached to sternum and acromion, latter being indistinctly felt. III. 1–4, 8–10, seven sons of II. 3, were said by him to have a similar condition of one or both clavicles. III. 6, 7, two daughters not affected. III. 5 died at 11th year; both clavicles abnormal.

CYRIAX, E. F.: A Case of Cleido-cranio Dysostosis. Edinburgh Med. J., XXX, 600, 1923.

DAVIES, H. M. and POYNTON, F. J.: Case of Cleido-cranio Dysostosis in which the Removal of the Outer Part of the Imperfect Right Clavicle Relieved Severe Symptoms from Pressure on the Brachial Plexus. Proc. Roy. Soc. Med., VIII, Sect. Dis Child., 21, 1914–1915.

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DEVRIES, HUGO: Species and Varieties, Their Origin by Mutation. Ed. 2. Chicago, The Open Court Pub. Co., 1906.

DOWSE, T. S.: Congenital Deformity of Clavicles. Trans. Pathol. Soc. London, XXVI, 166, 1875.
Female, 15, eldest of 8 of whom 2 died young, others healthy; mother normal. Head appeared flat at birth and shoulders very mobile; teeth erupted at 3 months, epilepsy from 9th year, nervous affection of limbs at 12; head large with prominent parietals and frontals and median furrow; teeth irregular, decayed; only sternal ends of clavicles perceptible.

DURANTE, G. ET PORAK, C.: Les Micromélies Congénitales. Nouv. Iconog. de la Salpêtrière, XVIII, 481-538, 1905.
On p. 520 it is suggested that cleidocranial dysostosis may be a partial form of *dysplasie périostiale*, which is characterized by defective periosteal ossification with tendency to multiple fractures.

EVANS, A.: A Case of Cleidocranial Dysostosis. British Med. J., I, 195, 1914.

FITZWILLIAMS, D. C. L.: Hereditary Cranio-Cleido-Dysostosis. Lancet, II, 1466, 1910.
A good account, with tabulation of 59 reported cases. Also describes a new case; female, 8, right clavicle in two parts, sternal two-thirds over-riding acromial one-third, thickened ends and ligamentous union, shoulder depressed.

FRANÇOZ, L. ET VILLARET, M.: Une Famille de quatre Sujets atteints de Dysostose cleido-crânienne héréditaire. Nouv. Iconog. de la Salpêtrière, XVIII, 302, 1905.
An excellent account of the anomaly, with tabulation of 28 recorded cases, and full description of four new cases in one family. IV. 3, spindle-shaped tibiae, deformed pelvis; frontal and parietal eminences protuberant with pronounced median furrow; fontanelles not closed until 10th year; palate arched and perforated posteriorly; mandible slightly prognathous; teeth small and irregular; left clavicle showed exaggerated curves; right clavicle divided into sternal portion articulating with sternum, overlapping and forming fibrous pseudarthrosis with small acromial portion. V. 4, examined in 9th year; large head and small face; frontal median furrow, parietal and occipital eminences pronounced, ossification of vault not completed until 7th to 8th year; palate arched; teeth retarded; shoulders drooping and could be brought into contact forwards; scapulae prominent with projection on each spine; clavicles divided into mobile conical sternal portion ending in a free point beneath skin, and an atrophied acromial fragment fixed to scapula; fragments joined by a fibrous cord; pectoral, deltoid, and sternomastoid muscles attached to sternal part. V. 6, aged 6, large forehead with deep median furrow, prominent parietal eminences, projecting occiput; anterior fontanelle had closed only 9 months before; palate arched; clavicles divided into sternal portion and acromial, loosely attached without fibrous union; shoulder ligaments very lax and humeri could be subluxated; scapulae mobile and "winged" with nodules on spines. V. 7, aged 21 months; normal clavicles; head large; frontal and parietal eminences prominent with median furrow; anterior fontanelle extended back from 2 cm. above nasion, widening to 6 cm. at bregma and running into sagittal suture 2 cm. wide to posterior fontanelle; this cleft was 20 cm. long and closed by pulsatile membrane; palate highly arched; teeth retarded.

FRANK, E. S.: A Case of Dysostosis Cleidocranialis. Nederl. Tijdschr. v. Vergelijk. Geneesk., LXVI, Pt. 2, 1224, 1922.

FUCHS, A.: Ein Fall von Scheuthauers Kombination rudimentärer Schlüsselbeine mit Anomalien des Schädels (Dysostose cleido-crânniene). Wiener klin. Wchnschr., XX, 763, 1907.

Male, 23, twin, 148 cm., intelligent; very large head; arrested development of jaws; very broad forehead; clavicles small, with movable attachment to sternum. Living members of family normal.

GARRAHAN, J. P. and SCHINELLY, J. C.: Sobre Disostosis cleidocráneana hereditaria. Cuatro Casos en una Familia. Prensa méd. Argentina, XII, 368, 1925–26.

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GEGENBAUR, C.: Ein Fall von erblichem Mangel der Pars acromialis Claviculae mit Bemerkungen über die Entwickelung der Clavicula. Jenaische Ztschr. f. Medizin u. Naturw., I, 1, 1864.

Untersuchungen zur vergleichenden Anatomie der Wirbelthiere. Leipzig, II, 1865.

II. 2, clavicles consisted only of inner fragments attached to sternum; the right was directed towards acromion, left somewhat higher, and free ends could be grasped, no ligamentous attachments being evident; subclavius muscles absent, clavicular heads of deltoid and trapezius inserted into acromion, clavicular heads of pectorals poorly developed. III. 2, aged 36, clavicles consisted only of sternal fragments; no other defects. III. 4, aged 22, right clavicle was divided into sternal portion articulating normally with sternum, and acromial fragment attached to acromion and also to sternal part by a ligament; left clavicle divided into sternal and acromial parts, slightly overlapping. III. 5, aged 14½; right clavicle divided into sternal and a small acromial fragment forming a pseudarthrosis with it; left clavicle consisted only of sternal portion extending nearly to acromion and apparently forming a kind of pseudarthrosis with it. Children by two husbands.

GIANNETTASIO, N.: Assenza congenita delle Clavicole. Arch. di Orthop., XVI, 65, 1899.

Male, 54, short stature, synostosis of cervical vertebrae, dorsal scoliosis, lumbar lordosis, left limbs some 12 cm. shorter than right, left facial hemiatrophy, short asymmetrical thorax; head large and deformed, very brachycephalic, anterior fontanelle not ossified, posterior depressed, frontal prominences exaggerated, face short, marked prognathism; clavicles consisted of thin pointed rudiments attached to sternum, outer ends free; left scapula displaced.

GIBERT: Quels Rapports peuvent exister entre Rachitisme et la Syphilis? Havre, Imprimerie du Commerce, Obs., IV, 19, 1888.

Female, 15, born with weak limb bones and extensive cranial defect; parietal bones and frontal plate absent, squamous portions of occipital and temporals not ossified; clavicles completely absent; died of acute osteomyelitis.

GREIG, D. M.: A Case of Cleido-cranial Dysostosis. Edinburgh Med. J., XVI, 49, 1916.

Female, 47, square-shaped head, prominent frontal eminences, flat vertex, depressed interfrontal suture; slight kyphosis; high palate with median groove, flat broad nasal bridge; medial parts of clavicles absent, end portions present; shoulders could be voluntarily approximated in front. Heredity not mentioned.

GROSS, A.: Über angeborenen Mangel der Schlüsselbeine. Münchener med. Wchnschr., I, 1151, 1903.

Female, 12, rachitic; clavicles only 2 cm. long, cartilaginous sternal rudiments, trapezius and deltoid attachments missing; scapulae winged, heads of humeri easily subluxated; head brachycephalic, with projecting bosses and depressed frontal suture, broad nasal bridge, high angular palate; parents and brothers and sisters free from anomalies.

GUZZONI DEGLI ANCARINI, A.: Un Caso rarissimo di anomalie delle Clavicole. Bollettino scientifico, IX, No. 3, 72, 1887.

Female, 60, of good health and intelligence; dorsal kyphosis; clavicles consisted of only sternal rudiments, the right without evident connection with acromion, left with firm cord-like attachment to scapula; shoulders displaced forwards and down; parents healthy.

Atti della Soc. medico-chirurgica in Modena nel anno accad., 19, 1883.

Bollettino del XII congresso medico di Pavia, No. 10, 4, 1887.

HAMILTON, F. H.: A Practical Treatise on Fractures and Dislocations. Ed. 4, Philadelphia, 32, 1871.

Infant seen in 1853, child of healthy mother; feeble and marasmic, died at 6 months; clavicles completely missing, fontanelles unusually large; long bones thick with loosening of epiphyses.

HAMILTON, W. F.: A case of Congenital Deficiency of Both Clavicles. Phila. Med. J., IV, 720, 1899.

Female, 38; late in walking, first teeth at 2; lumbar lordosis, talipes planus, lax joints, winged scapulae; clavicles consisting of sternal fragments ending in fibrous cords; frontal eminences prominent with median furrow. One brother died of phthisis, 6 brothers and sisters normal.

HEINECKE, P.: Über kongenitalen Schlüsselbeindefekt. Ztschr. f. orthop. Chir., XXI, 553, 1908.

HESSE, G.: Dysostosis cleidocranialis unter besonderer Berücksichtigung des Gebisses. Vrtljschr. f. Zahnh., XLI, 161, 1925.

HIRTZ, E. et LOUSTE: Dysostose cleido-crânienne. Bull. et mém. Soc. méd. d. Hôp. de Paris, Série 3, XX, 270, 1903.

Male, 49, walked at 3, dentition delayed, incomplete and irregular; subject to asthma and emphysema; clavicles consisted only of sternal fragments; shoulders very mobile; phalanges of fingers could be readily dislocated; frontal region bossed with median depression, anterior fontanelle incompletely ossified; nose depressed, zygomatic arches small, mandible prognathous, palate grooved; only son of normal parents.

Progrès méd., Série 3, XVII, 186, 1903.

Semaine méd., XXIII, 79, 1903.

HULTKRANTZ, J. W.: Über congenitalen Schlüsselbeindefect und damit verbundene Schädelanomalien. Anatom. Anz., XV, 237, Dec. 1898.

Describes case without hereditary history; mother and three daughters. III. 2, said to have had medial part of cranial vault soft at birth; at 38, pelvis contracted; head large; large triangular depression at lambda, broad groove between temporal plate and mastoid, palate high and small, mandible prognathous; transverse processes of seventh cervical vertebra enlarged; right clavicle consisted of sternal rudiment, left clavicle divided into sternal and acromial portions; shoulders low, humeral heads subluxated inwards. IV, 1, at 3½ years, fontanelles still open, sutures palpable; clavicles rudimentary; at 13, clavicular rudiments, right 4.5 cm., left 1.4 cm. and nodules on scapular spines; teeth erupting imperfectly. IV. 2, at 11 years, sutures closed but furrowed; anterior fontanelle 1 cm. diameter; palate small with median gutter; 2nd teeth delayed; clavicular rudiments, right 4.5 cm. and left 1.5 cm. IV. 3, at 9½ years, cranial sutures partly closed; anterior fontanelle open with evident pulsation; exophthalmos apparent; dentition delayed; clavicular defects on both sides. IV. 5, at 7 months, showed rickets; forehead square, parietals separated by gap 5 cm. wide extending to anterior fontanelle; left clavicle normal; right clavicle divided into sternal fragment and acromial portion.

HULTKRANTZ, J. W.: Über Dysostosis Cleido-cranialis: kongenitale kombinierte Schädel- und Schlüsselbeinanomalien. Ztschr. f. Morphol. u. Anthrop., XI, 385, 1908.

An excellent detailed account of the anomaly, emphasizing the head characteristics, which may be present alone. He describes (1) two families: the history of the first is outlined above; the second consisted of a mother and two sons. II. 2, showed large cranium with prominent frontal and parietal eminences and median furrow; appearance of exophthalmos; palate high; clavicles slender with ends poorly developed and presented unevenness in middle of shafts. III. 4, aged 20; head large with prominent frontal and parietal eminences and depressed median suture; palate small and high with anterior median furrow, dentition late and irregular; right clavicle divided into sternal and acromial portions, left clavicle small and flattened horizontally at sternal end. III. 8, at 7 years, head large with prominent frontal and parietal eminences; frontal suture open posteriorly; anterior fontanelle very large with evident pulsation; teeth irregular and carious; both clavicles divided into thin compressed sternal portions ending in stumps, and thin acromial portions. (2) A case without family history excepting that the father had a very broad forehead; this was a female, 56, large forehead, prominent frontal bosses, and median furrow nasion to lambda; mandible prognathous; clavicles consisted of sternal fragments. (3) A series of skulls showing characteristic dysostotic lesions, of which three had not previously been described. There is also a fairly complete bibliography up to 1907, with abstracts of cases.

INFROIT, VOISIN, R., et DE LÉPINAY, M.: Étude Clinique et radiographique d'un Cas de Dysostose cleido-crânienne. Nouv. Iconog. de la Salpêtrière, XX, 227, 1907.

Female, 16, with very strong dorsal kyphosis with scoliosis and deformed thorax; cranium large and brachycephalic; frontal bosses with median furrow, fontanelles open, palate high with incomplete fusion of bones; teeth carious; right clavicle only a fragment without apparent articulation; rest fibrous; left clavicle joined to sternum but not acromion; shoulders could be approximated in front; congenital dislocation of head of radius; slight genu valgum and flat-foot.

JANSEN, M.: La disostosi cleidocranica. Arch. di Ortop., XXXV, 270, 1919 (Translation in J. Orthop. Surg., XXX, 468, Sept. 1921).

Die Dysostose cleido-crânienne. Ztschr. f. orthop. Chir., XL, 487, 1920–21.

La Dysostose cleido-crânienne. Arch. di Ortop., XXXV, 306, 1919.

JOHNS, S. M.: Congenital Fracture of the Clavicle with other Faulty Bony Conformations. Journal-Lancet (J. Minnesota State Med. Assn.), XXXV, 530, 1915.

Describes four brothers with congenital division of clavicles. Parents, one brother and one sister healthy. (1) M. C., aged 24, showed division of right clavicle at junction of middle and outer thirds, fragments overlapping with fibrous union; also similar overlapping with callus at same point on left clavicle; exaggeration of frontal and occipital prominences, asymmetry of sternum. (2) T. C., 17, showed division of both clavicles at junction of middle and outer thirds, inner fragments overlapping in front of and above the outer with fibrous union; frontal prominence enlarged. (3) W. C., 14, showed similar condition of right clavicle with extensive overlapping and angular deformity of left clavicle with firm union and callus formation at junction of fragments; enlarged frontal prominence, slight lordosis, ribs thickened and small. (4) F. C., 12, showed gap between fragments of right clavicle which were incompletely developed, also thickening of left clavicle at point of union of fragments; teeth irregular; talipes varus, deformed thorax, and thickening of frontal bones.

KAPPELER, O.: Ein Fall von fast totalem Mangel der Schlüsselbeine. Arch. d. Heilk., XVI, 265, 1875.

Female, 16, with congenital pes varus; spondylitis and tubercular gland and lung apex; head showed only prominent frontal bosses with median furrow, broad nasal bridge; upper thorax flattened, shoulders drooping, scapulae small, heads of humeri subluxated down and in; clavicles consist of sternal fragments, loosely attached to sternum; clavicular parts of muscles apparently missing.

KING, A.: A Case of Congenital Malformation of the Clavicle in Two Children Simulating an Accidental Condition of the Mother. Ann. Surg., XXX, 215, 1899 (Description given above).

KLAR, M. W.: Über kongenitale Osteodysplasie der Schlüsselbeine, der Schädeldeckknochen, und des Gebisses. Ztschr. orthop. Chir., XV, 424, 1905–06.

(1) Female, 18½, born prematurely, dentition at 2 years, fontanelle closed at 2nd year, midfrontal region unossified until 4th year; clavicles divided into sternal fragments and slender acromial parts; large bosses with deep median depression nasion to bregma; face asymmetrical, mandible prognathous, palate high, teeth scanty. (2) Male, 10, had open anterior fontanelle until 4th year, congenital double coxa vara, spinal curvatures; right clavicle consisted of sternal rudiment prolonged to acromion by a cord, left clavicle of sternal and acromial fragments; head with prominent bosses and median oval elongated depression, nasion deeply sunken, mandible prognathous.

KRABBE, K. H. and FOGED, J.: Cleidocranial dysostosis. Bibliot. f. Laeger, CXVI, 600, 1924.

KRABBE, K. H.: Dysostosis Cleidocranialis with Metabolic Disturbances. J. Nerv. and Ment. Dis., LXI, 18, 1925.

KREBS, O. and TERRY, R. J.: Dysostosis Cleidocranialis. J. Missouri State Med. Assn., XIX, 522, 1922.

La Chapelle, E. H.: Dysostose cleido-crânienne héréditaire. Rotterdam. Van Vleet, 1918.

Description of an affected family, analysis of 89 reported cases, photos, radiographs, and fairly complete bibliography. III. 6, aged 45, projecting forehead, appearance of exophthalmos; mandible prognathous, median furrow on frontal bone; dentition late and incomplete; clavicles both divided; muscles inserted into fragments; humeri short. Parents, brothers and sisters normal except one who exhibited a "*forme-fruste*" of dysostosis; his clavicles normal. Five of III. 6's ten children affected. IV. 5, aged 25, showed prominent frontal eminences, median furrow and depression at anterior fontanelle; mandible prominent; clavicles divided into sternal and acromial portions. IV. 6, aged 23, frontal eminences prominent with median furrow; anterior fontanelle closed with raised margin; palate asymmetrical, teeth irregular; clavicles divided into two mobile fragments; double flat-foot, genu valgum. IV. 12, delicate boy aged 12; abnormal head; median frontal furrow running into an incompletely closed fontanelle; clavicles divided. IV. 13, one of twins, showed deficient ossification of cranial vault at birth; at 9th year, anterior fontanelle still open, head large; clavicles divided into mobile cartilaginous sternal fragments and short bony acromial fragments. IV. 14, twin brother, showed an identical cranial defect at birth and died soon after.

Langmead, F.: A Family Showing Cleido-cranio Dysostosis. Proc. Roy. Soc. Med., X, Sect. Dis. Child., 1, 1916–17. An extension of Carpenter's study; see above.

de Lépinay, M., Voisin, R., et Infroit: See Infroit.

Léri, A. and Trétiakoff: Autopsie d'une Dysostose cléido-crânienne: grosses Lésions inflammatoires et hémorragiques méningo-encéphaliques (Defective Ossification of Scull and Clavicles). Bull. et mém. Soc. méd. d. Hôp. de Paris, Série 3, XLVII, 1091, 1923.

Louste et Hirtz, E.: See Hirtz.

McBride, E. D.: Congenital Deficiency of Clavicle; Hereditary Cleidocranial Dysostosis. J. Bone and Joint Surg., IX, 545, July 1927.

McCurdy, I. J. and Baer, R. W.: Hereditary Cleidocranial Dysostosis. J. Am. Med. Assn., LXXXI, 9, 1923.

Maldaresco, N. and Parhon, C.: Sur un Cas de Dysostose cleido-crânienne. Nouv. Iconog. de la Salpêtrière, XXV, 251, 1912.

Male, 40 years, dorsal scoliosis, short neck, drooping shoulders, slight genu valgum, double flat-foot, poor intelligence; head showing median frontal furrow and large depression 4 cm. diameter at anterior fontanelle, groove in occipital region with flattening; face poorly developed, apparent exophthalmos, palate arched and asymmetrical, teeth defective; clavicles consisted of 6 cm. fragments, mobile at both ends, representing sternal portions; nothing known of parents, 10 brothers and sisters not known to be abnormal.

Manouvrier, L.: Mémoire sur les Variations normales et les Anomalies des Os nasaux dans l'Espèce humaine. Bull. Soc. d'Anthropol., Série 4, IV, 729, 1893.

Skull, unknown origin, elderly individual; broad and short, flattened vertex; persistent frontal suture ending in large irregular anterior fontanelle; posterior fontanelle closed; temporal bones maldeveloped; face small with high orbits and small flat palate; teeth poorly developed.

Marie, Pierre et Sainton, Paul: Observation d'Hydrocéphalie héréditaire (père et fils) par Vice de Développement du crâne et due cerveau. Bull. et mém. Soc. méd. d. Hôp. de Paris, XIV, 706, 1897.

II. 3, aged 39, right hemiplegia and slight genu valgum; head rounded with predominance of cranial over facial development; large frontal protuberances with median furrow running into depression at anterior fontanelle which was incompletely ossified; posterior fontanelle similar, and posterior part of cranium flattened; lower jaw prognathous; teeth very defective and irregular; palatine arch incompletely ossified with median gap; right clavicle divided by median depression, sternal fragment immobile; left clavicle apparently normal except that sternal end was deeply placed. III. 1, aged 12, small for his age, but head appeared very large; frontal prominences exaggerated with median furrow ending in open anterior fontanelle; frontoparietal sutures depressed; parietal protuberances large, facial bones small, palate highly arched; teeth very irregular; right clavicle consisted of acromial half only, articulating with acromion and ending near coracoid; left clavicle divided into two mobile portions separated by fibrous tissue. III. 2, died in convulsions at 2½ years; anterior fontanelle not closed and head deformed like that of III. 1.

Résumé of same case. Rev. Neurol., V, 394, 1897.

La Dysostose cleido-crânienne héréditaire (Hydrocéphalie héréditaire). Bull. et mém. Soc méd. d. Hôp. de Paris, XV, 436, 1898. Rev. Neurol., VI, 739, 1898.

II. 2, aged 47, showed broad head with large frontal and parietal eminences, persistent anterior fontanelle and sagittal suture, prognathous mandible and complete loss of teeth; clavicles consisted of small sternal fragments; genu valgum. III. 1, at 10 years, head large with prominent frontal, parietal, and occipital eminences, persistent anterior fontanelle and highly arched palate; clavicles consisted only of sternal fragments; genu valgum and flat feet.

Sur la Dysostose cléidocrânienne héréditaire. Rev. Neurol., VI, 835, 1898.

A review of the 4 cases described above, with comments on some of the characteristics of the anomaly.

Martin: Sur un Déplacement naturel de la Clavicule. J. de Méd. Chir. et de Pharmacol, XXIII, 456, 1765.

I. 1, II. 1, and II. 2, presented the same abnormal mobility of the shoulders and presumably had abnormal clavicles. II. 1, aged 30 was admitted to hospital in 1764 with apparent fracture of clavicle; one clavicle was found to be only ¾ the length of the other, which was apparently normal; it was normally attached to sternum, but failed to reach the acromion.

Maygrier, C.: Opération Césarienne. L'Obstétrique, I, 328, 1896.

I. 1, presented highly arched palate; clavicles divided into sternum and acromial fragments, overriding at free ends. II. 2, aged 19, feebly developed with contracted pelvis necessitating Caesarian section; at 22, head showed pronounced frontal and parietal bosses with sagittal furrow, closed

fontanelles, highly arched palate and defective teeth; clavicles divided into two fragments, the acromial fragment on the right overlapping the sternal; sternum bent at 145 degrees with projecting angle. II. 3, a female child, deceased, was said to have had the same malformation of clavicles as her father. II. 4, had a natiform head, highly arched palate, and angular deformity of clavicles without actual solution of continuity. III. 2, aged 9 months, had large fontanelles, frontal and other sutures being also widely open.

MILLER, R. H. and POYNTON, F. J.: Cleido-cranial Dysostosis. Proc. Roy. Soc. Med., II; Sect. Dis. Child., 5, 1908–09.
Pathological specimens from male child, dead of marasmus at 3 months, cranium showing great defects in development of bones; left clavicle rudimentary, sternal part attached to first rib and coracoid; right clavicle presumably normal; brothers and sisters normal.

MONTANARI, U.: Acondroplasia e Disostosi cleido-cranica-digitale (Case of Achondroplasia with Defective Ossification of Skull, Clavicles and Fingers). Chir. d. Org. di Movimento, VII, 379, 1923.

MORAND: Observations anatomique. Histoire de l'Académie royale des Sciences. Paris, IV, 47, 1766.
Infant born 1759, lived only 20 hours; absence of clavicles, sternum, and costal cartilages, heart and lungs being exposed—not a typical case of dysostosis.

MOREIRA, GODOY: La Disostosi cleido-cranica come Malattia ereditaria; suoi Rapporti con altre Forme di Disostosi congenite. Chir. d. Org. di Movimento, X, 225, 1925–26.

MOREIRA, F. E. GODOY: Cleidocranial Dysostosis as Hereditary Disease. Brazil. med., XLI, 273; 304; 342, 1927.

MOUCHET, A.: Aplasie claviculaire, Absence partielle ou totale de la Clavicule; Dysostose cleido-crânienne héréditaire. Paris Méd., 556, 1910–1911.

NETTESHEIM, W.: Über Dysostosis cleido-cranialis (Cleidocranial dysostosis). Monatschr. f. Geburtsh. u. Gynäk., LXXII, 159, 1926.

NIEMEYER, P.: Defekt des ganzen linken Schlüsselbeins. Tagebl. d. Versamml. deutsche Naturf. u. Ärzte., XL, 68, 1865.
Youth, scoliotic; left clavicle represented by sinewy band to which muscles were attached; clavicular head of pectoralis missing; function of shoulders normal. No heredity mentioned.

PAGÈS, PARÈS, et CONTE: Un Cas de Dysostose cleido-crânienne. Bull. Soc. de Sc. Méd. et Biol. de Montpellier, VI, 319, 1924–25.

PALTAUF, RICHARD: Demonstration eines Skelettes von einem Falle von Dysostosis cleidocranialis. Verhandl. d. deutsch. path. Gesellsch., XV, 337, 1912.

PARHON, C. and MALDARESCO, N.: See MALDARESCO.

PATERSON, A. M.: Development of the Sternum and Shoulder Girdle in Mammals. British Med. J., II, 777, 1902.
Clavicle develops in mammals in two parts, inner ossified in cartilage, outer in membrane; possibly separate morphological units.

PIERRE, P. A.: De la Dysostose cleido-crânienne héréditaire. Thèse de Paris, No. 406, 1898.

PILLSBURY, H. C.: Congenital Absence of the Clavicles (Hereditary Cleidocranial Dystosis); Report of Case. Am. J. Roentgenol., XVIII, 322, Oct. 1927.

PINARD et VARNIER: Compt. rend. Soc. d'Obstét., de Gynéc. et de Pédiat. de Paris, I, 130, 1898–1899. (The same case as seen by Maygrier. See MAYGRIER above.)

PORAK, C. et DURANTE, G.: See Durante.

POYNTON, F. J. and MILLER, R. H.: See Miller.

POYNTON, F. J.: Case of Cleido-cranial Dysostosis with Signs Pointing to Pressure on the Brachial Plexus by the Rudimentary Right Clavicle. Proc. Roy. Soc. Med., VII, Clin. Sect. 50, 1913–1914.

POYNTON, F. J. and DAVIES, H. M.: See Davies.

PRELEITNER, K.: Zwei Fälle von angeborenem partiellen Claviculardefekt. Wiener klin. Wchnschr., XVI, No. 3, 70, 1903.
II. 1, aged 12, shoulders drooped forward, scapulae winged, supraclavicular fossae appeared large; clavicles consisted of sternal and acromial fragments with club-shaped free ends united by fibrous pseudarthrosis, both fragments freely mobile. II. 2, aged 8, drooping and unduly mobile shoulders; clavicles divided into sternal fragments and acromial, joined by pseudarthroses; frontal eminences with exaggerated transverse diameter of head.

PROCHASKA, G.: Disquisitio anatomico-physiologica organismi corporis humani. Vienna, 1812.
Description of skull: Male, 33, cretin, double hip dislocation; only inner fragments of clavicles with ligaments extending to acromion; large open anterior fontanelle and cleft extending from bregma to 4 cm. above nasion. (Details from J. W. Hultkrantz.)

RAUBITSCHEK, H.: Zur Kenntnis der Dysostosis cleidocranialis. Beitr. z. path. Anat. u. z. allgemeinen Path., LXI, 131, 1915.
Detailed description of female skeleton, with extreme kyphoscoliosis; very low cranium and short face; prominent frontal bosses, flat occiput, incomplete zygomatic arches; small maxillae; asymmetry of cranium; irregularity at junction of middle-outer thirds of right clavicle; pelvis malformed.

REICHMANN, M.: Kongenitaler Defekt beider Schlüsselbeine. Fortschr. a. d. Geb. d. Röntgenstrahlen., XVIII, 207, 1911–1912. (Translation in J. Am. Med. Assn., LIX, 1192, 1912.)
Male, 32, small in size, neither clavicle palpable, but strong cords felt in their place; shoulders could be approximated in front; skull apparently normal; parents and sister thought to be normal.

REMIJNSE, J. G.: Dubbelzijdige aangeboren ontwrichting van het kopje van het sleutelbeen. Nederl. Tijdschr. v. Geneesk., I, 1336, 1909.

RICH: Demonstration eines Skelettes von einem Fall von Dysostosis cleidocranialis. Verhandl. d. deutschen path. Gesellsch., XV, 337, 1912. For further details, see FUCHS, A.

ROMITI, G.: Sopra la incompiutezza dell' arco zigomatico. Atti. Soc. Toscana di Scienze naturali, XIV, 352, 1895.

Skull of a Bolivian male; frontal suture open throughout; anterior fontanelle open; face relatively short and small; orbits high; lachrymals fused with maxillae, nasals small, maxillary sinuses small, malar bones undeveloped, zygomata incomplete; palate high and grooved; rami of mandible small.

ROUSSY, G. et AMEUILLE: Présentation de Pièces provenant de l'Autopsie d'un Cas de Dysostose cleido-crânienne héréditaire. Rev. neurol., XVII, 815, 1909.

SACHS, A.: Über angeborene Defekte der Schlüsselbeine. Leipzig, 1902. Summary of 21 cases collected from the literature.

SAINTON, PAUL and MARIE, PIERRE: See MARIE, PIERRE.

SCHEUTHAUER, G.: Kombination rudimentärer Schlüsselbeine mit Anomalien des Schädels, beim erwachsenen Menschen. Allgemeiner Wiener med. Z g., XVI, 293, 1871.

Describes two skulls in Path. Museum, Vienna. (1) No. 2258 (female, sexagenarian) showing defect extending backwards from 5 cm. above nasion, with anterior opening 3 x 1 cm., posterior 2 x 1.5 cm.; also rudimentary clavicles, remainder having been represented by fibrous bands. (2) No. 3061 (male, 52) with defect 10 cm. long starting 3 cm. above nasion, broad at fontanelles; the clavicles were only rudimentary.

SCHORSTEIN, G.: A Case of Congenital Absence of Both Clavicles. Lancet, I, 10, 1899.

Female, 13, small, rachitic history; walked at age 4, anterior fontanelle closed at 9 years; depressions at both fontanelles evident at 13, frontal and parietal eminences prominent with median furrow; inner thirds of clavicles present only, shoulders drooping and very mobile; teeth carious. Parents and 3 brothers healthy.

SHATTOCK, C. E.: Case of Dysostosis cleido-cranio (-digitalis). Proc. Roy. Soc. Med., XV, Clin. Sect. 4, 1922.

SHERMAN, H. M.: Congenital Absence of Clavicles, with Photograms and Radiograms: Cleidocranial Dysostosis. Trans. Am. Orthop. Assn., XV, 386, 1902.

Report of a Case of Congenital Deficiency of the Clavicles with Photogram and Radiogram. Med. Rec., LXII, 232, 1902.

Congenital Absence of the Clavicles, with Photograms and Radiograms: Cleidocranial Dysostosis. Philadelphia Med. J., XI, 663, 1903.

SIMS, H. S. and COCKER, A. B.: See COCKER, A. B.

SIMONS: Ein äusserst seltener Fall von Hemmungsbildung. Deutsche militär-ärztliche Ztschr., XXV, 331, 1896.

Male, 22, with divided clavicles, the left sternal fragment over-riding the acromial part as in a fracture; fontanelles closed but easily palpable; palate highly arched. (For abstract, see Hultkrantz, J. W.)

SPRIGGS, E. I.: A Case Showing Division of the Clavicles into Two Halves, with Other Bony Deformities. Cleido-cranial Dysostosis. Lancet, II, 1599, 1907.

STAHL, F. C.: Neue Beiträge zur Physiognomie und pathol. Anatomie der Idiotia endemica. Erlangen, 53, 1848.

Female, aged 4½, imbecile and partly deaf; frontal bosses, anterior fontanelle partly open; clavicles appear to have been fractured. Family normal. (Details from abstract by Hultkrantz, J. W.)

STAHMANN, F.: Angebornes Fehlen des linken Schlüsselbeins bei einem Knaben von 9 Jahren. Ztschr. f. Med. Chir. u. Geburtshülfe, XI, 443, 1857.

Male, aged 9, had suffered from "congestive condition of head"; healthy, well built; left clavicle represented only by a fibrocartilaginous mass; function normal.

STEINDLER, ARTHUR: Diseases and Deformities of the Spine and Thorax. St. Louis, The C. V. Mosby Co., 1929.

STERN, W. G.: Report of Case of Congenital Absence of Both Clavicles. J. Am. Med. Assn., LXXIII, 1526, 1919.

STILL: A Case of Cleidocranial Dysostosis. Trans. Med. Soc. London, XXXI, 350, 1908.

Male, 6, late in walking and talking, peculiar facies, last phalanges of thumbs shortened, head large for age, anterior fontanelle unossified; clavicles absent in outer one-third or one-half with free blunt ends, and very slender; shoulders could be approximated in front; no similar cases in family.

STOCKS, PERCY: Hereditary Disorders of Bone Development. (The Treasury of Human Inheritance. Edited by Karl Pearson. Eugenics Laboratory Memoirs, XXII.) III, Pt. 1. London. Cambridge University Press, 1925. This contains a bibliography, with brief abstracts, to 1925, which is the best obtainable; it has been freely quoted in the present abstract, and brought up to date.

TAYLOR, S.: Case of Congenital Absence of Both Clavicles. Lancet, II, 1197, 1901. Trans. Clin. Soc. London, XXXV, 171, 1902.

Male, 20, signs of congenital syphilis; clavicles incomplete, sternal ends with sternomastoid attachments felt, and some attempt at development at outer ends, fibrous tissue between; subject unaware of defect, but shoulders could be approximated in front; family history not obtainable.

TERRY, R. J.: Rudimentary Clavicles and other Abnormalities of the Skeleton of a White Woman. J. Anat. and Physiol., XXXIII, 413, 1899.

Skeleton, prepared 1887 by Todd, of small aged female; bones brittle, dorsal scoliosis, high compressed pelvis; clavicles slender, tapering and deficient at acromial ends with fibrous attachments to coraco-acromial ligaments; acromial processes detached from scapulae; broad cranium with wide median fissure, parietal foramina, prominent frontal eminences, small rudimentary temporals

with patent sutures, incomplete zygomatic arches, low face, large orbits, prognathous mandible, large palatine foramen.

Also, A skeleton with Rudimentary Clavicles, Divided Parietal Bones, and other Anomalous Conditions. Am. J. Anat., I, 509, 1901–1902.

TODD, C.: Absence of Clavicles. St. Louis Courier of Medicine., XIX, 373, 1888. The same case as that described by Terry, R. J. See abstract above.

TUBBY, A. H.: Deformities Including Diseases of the Bones and Joints. Ed. 2, London, I, 30, 1912.

Contains account of cleido-cranial dysostosis, illustrated by radiograms and photos of Sherman's cases and photos of Carpenter's and Schorstein's cases.

VARNIER et PINARD: See PINARD.

VILLARET, M. et FRANÇOZ, L.: See FRANÇOZ.

VOISIN, R., DE LÉPINAY, M., et INFROIT: See INFROIT.

VOISIN, J., VOISIN, R., AND DE LEPINAY, M.: Un Cas de Dysostose cleido-crânienne. Bull. et mém. Soc. d. méd. d. Hôp. de Paris, Série 3, XXIV, 130, 1907. This article contains a bibliography to twenty-eight previous cases.

WALSHAM, W. J.: Congenital atrophy of Clavicles. Lancet, II, 869, 1888.

Peculiar Abnormalities of the Clavicles in a Boy. British J. Med., II, 994, 1888.

Boy, subject of rickets and scoliosis, with no signs of clavicles "or at any rate of acromial end"; thought to be a case of ununited fracture dating from infancy; function good.

WULFF: Über kongenitalen doppelseitigen partiellen Defekt der Clavicula. Verhandl. d. freien Vereinigungen d. Chirurgen. Berlin, 110, 1900.

Also Deutschen med. Wchnschr., XXVII, Vereinsbeil, 69, 1901.

I. 1, had scoliosis and malformation of cranium similar to that of II. 1. II. 1 showed pronounced scoliosis, and drooping shoulders which could be brought forwards within a few cm. of each other; heads of humeri seemed displaced downwards and inwards, and bound to scapula by a strong ligament which by X-ray appeared cartilaginous; frontal and parietal eminences of cranium very prominent; posterior fontanelle very depressed, and right limb of lambdoid suture strongly marked; teeth defective. (Also described by Sachs.)

YTTRI, J.: Bidrag til sporsmaalet om dysostosis cleido-cranialis congenita (Congenital Cleidocranial Dysostosis. Malformation of Clavicles and Skull). Norsk Mag. f. Laegevidensk., LXXXI, 129, 1920.

ZILKENS: Zahnbefunde bei zwei Fällen von Dysostosis cleidocranialis (Dental Findings in Two Cases of Cleidocranial Dysostosis). Deutsche Monatschr. f. Zahnh., XLV, 477, 1927.

ROBERT TUNSTALL TAYLOR

Robert Tunstall Taylor, one of Maryland's foremost orthopaedic surgeons, died suddenly at his home in Baltimore, Maryland, February 21, 1929, culminating a life of unselfish service to humanity. He was largely instrumental in arousing interest in orthopaedic surgery in Baltimore and its vicinity. He was even-tempered, an excellent teacher, painstaking in his efforts, and always courageous and hopeful under the most adverse circumstances.

Born January 16, 1867, in Norfolk, Virginia, he was graduated with the degree of A.B. from Johns Hopkins University in 1889, and received his M.D. from the University of Virginia in 1891. He began general practice in Baltimore, but became interested in orthopaedic surgery. He obtained his training under some of the foremost orthopaedic surgeons of Boston, New York, and Philadelphia. He also spent some time in Rochester, New York, studying roentgenology. Soon after Dr. Taylor returned to Baltimore, he founded and organized the Hospital for the Relief of Crippled and Deformed Children, the first hospital for crippled children south of Philadelphia. It was through his untiring efforts that, some years later, James Lawrence Kernan became interested in the work, and gave and endowed the hospital that now bears his name.

Dr. Taylor was Professor of Orthopaedic Surgery and head of that department at the University of Maryland, Orthopaedic Surgeon to the Women's, St. Agnes', and St. Joseph's Hospitals, consultant to the State Industrial Accident Commission, Surgeon-in-chief of the Kernan Hospital for Crippled Children, and consultant for a number of community hospitals outside of Baltimore.

During the World War he was commissioned Major in the Medical Corps of the United States Army, later being promoted to Lieutenant-Colonel. During the reconstruction period he was Chief of the Orthopaedic Service at Fort McHenry, Consultant to the United States Public Health Service, and to the United States Veterans' Bureau.

He was author of textbooks on orthopaedic surgery and treatment of diseases of the spine, and made a number of contributions to current medical literature.

He became interested in the inauguration of the inspection of children in the public schools and organized special classes in the schools for the teaching of crippled children. He was a member of the committee appointed to organize a city ambulance service and was instrumental in the establishment of the Walker-Gordon Laboratory in Baltimore.

He was also a Fellow of the American College of Surgeons, and member of the American Orthopaedic Association, American Medical Association, Medical and Chirurgical Faculty of Maryland, and Congress of Physicians and Surgeons.

In 1891 Dr. Taylor married Florence Templeman of Baltimore, who survives him. Although suffering from ill health during the last few years of his life, Dr. Taylor kept tenaciously on, and up to his death he gave himself whole-heartedly to his work, an attitude which throughout his career was an outstanding quality.

News Notes

JOINT MEETING

By invitation of the **British Orthopaedic Association** to the **American Orthopaedic Association,** a Joint Meeting of the two Societies was held in London, July 4, 5, and 6, 1929. While this was the first of its kind, it is hoped that the success of this meeting promises similar conferences in the near future.

On the day preceding the regular meeting, the guests were entertained, on their arrival in Liverpool, by Sir Robert Jones at a banquet to the members and other guests and their families. On July 3, at a meeting in the morning held at the Medical Institution, Mount Pleasant, Sir Robert Jones delivered an address:

On Fractures and Bone Setting.

And the following papers were also presented:

On Fractures of Lower Tibial Epiphysis.

Mr. B. L. McFarland, Liverpool.

Primary Nerve Lesions in Injuries of Wrist and Elbow.

Mr. R. Watson Jones, Liverpool.

After luncheon at the Adelphi Hotel, by invitation of Sir Robert Jones, the afternoon was devoted to demonstrations and operations by Sir Robert and his Associates.

On the following day, July 4, the Joint Meeting of the two Associations was opened at the Royal Society of Medicine, with Prof. Ernest W. Hey Groves and Dr. Fred Albee, the Presidents of the two Societies, presiding. After the meeting was formally opened, by Prof. Hey Groves, the President of the American Orthopaedic Association read his address on "Some Scientific Aspects of Orthopaedic Surgery". Prof. Hey Groves then presented the Robert Jones Medal to Mr. E. P. Brockman, of London, the reward for his prize essay on club-foot.

The program, arranged by the Executive Committee of the British Orthopaedic Association and the Program Committee of the American Orthopaedic Association, was continued as follows:

July 4

The Treatment of Fractures of the Neck of the Femur with Special Reference to the End Results.

Prof. Ernest W. Hey Groves, Bristol.

Dr. Royal Whitman, New York.

Discussion by Sir Robert Jones, Liverpool.

Dr. W. C. Campbell, Memphis, Tenn.
Dr. P. D. Wilson, Boston, Mass.
Dr. Samuel Kleinberg, New York.
Mr. T. H. Openshaw, London.
Mr. A. H. Tubby, London.
Mr. R. C. Elmslie, London.
Mr. A. S. B. Bankart, London.
Mr. W. R. Bristow, London.
Mr. S. T. Irwin, Belfast.

Clinical demonstrations bearing upon the same subject.

The Early Treatment of Congenital Dislocation of the Hip.

Prof. V. Putti, Bologna, Italy.

The Basic Principles Involved in the Treatment of the Common Spinal Conditions, as well as in the Function of the Viscera.

Dr. J. E. Goldthwait, Boston, Mass.

In the evening a reception was held at the Royal College of Surgeons, Lincoln's Inn Fields, by The President, Lord Moynihan of Leeds, Lady Moynihan, the Vice-Presidents

and Council. Following the reception, in the lecture theatre, Sir Arthur Keith, M.D., D.Sc., LL.D., F.R.S., Conservator of the Museum, presented a most interesting demonstration with epidiascope of museum specimens illustrating healing and disease in prehistoric times.

July 5.

Reconstructive Surgery in Paralytic Deformities of the Leg.
Dr. Melvin S. Henderson, Rochester, Minn.
(Read by Dr. A. Bruce Gill, Philadelphia, Pa.)
Mr. E. Laming Evans, London.
Discussion by Dr. Royal Whitman, New York.
Dr. F. R. Ober, Boston, Mass.
Dr. Leo Mayer, New York.
Dr. A. B. LeMesurier, Toronto, Canada.
Dr. W. H. Cole, St. Paul, Minn.
Mr. Naughton Dunn, Birmingham.
Dr. S. R. Cunningham, Oklahoma City, Okla.
Mr. T. H. Openshaw, London.
Operations and Clinical Demonstrations at the following Hospitals: Guy's, King's, St. Bartholomew's, and St. Thomas's.

In the evening the Association Dinner was held at the Café Royal, London, with Sir Robert Jones presiding and many guests present.

July 6.

The Treatment of Disabilities Resulting from Low Back Derangement.
Dr. E. G. Brackett, Boston, Mass.
Discussion by Dr. J. Torrance Rugh, Philadelphia, Pa.
Dr. Arthur Steindler, Iowa City, Iowa.
Dr. Z. B. Adams, Boston, Mass.

Defects in Modern Antiseptic Methods as Applied Especially to Infections of Bones and Joints.
Dr. H. Winnett Orr, Lincoln, Nebraska.
Discussion by Dr. F. J. Gaenslen, Milwaukee, Wis.
Mr. Harry Platt, Manchester.
Prof. E. W. Hey Groves, Bristol.
Dr. Alberto Inclan, Havana, Cuba.

The Present Status of Arthroplasty.—(Presented by title.)
Dr. William S. Baer, Baltimore, Md.

End Results in Operation for Drop-foot.
Dr. Willis C. Campbell, Memphis, Tenn.
Discussion by Mr. R. Ollerenshaw, Manchester.

Compensation Treatment of Scoliosis.
Dr. Arthur Steindler, Iowa City, Iowa.
Discussion by Dr. E. G. Brackett, Boston, Mass.

The Prehallux (Accessory Scaphoid) in Its Relation to Flat-foot.
Dr. Frederick C. Kidner, Detroit, Mich.
Discussion by Dr. DeForest P. Willard, Philadelphia, Pa.

In the afternoon a visit to Treloar's Hospital, at Alton, had been arranged, where the members were received by Colonel Lawson, Chairman of Trustees. An address was presented by Sir Henry Gauvain on "The Principles of Treatment Employed at Alton with Special Reference to Joint Tuberculosis". An opportunity was given for an inspection of the hospital.

At the Executive Session of the **American Orthopaedic Association** held on Friday, July 5, the appreciation of the courtesy received by the visiting members was expressed in the following resolution:

The American Orthopaedic Association, in Executive Session assembled, takes this opportunity of expressing its appreciation to the British Orthopaedic Association for its gracious hospitality, and its lavish expression of good fellowship. Closely bound to our British colleagues by every kind of human tie, we express the hope that this delightful Meeting may be the forerunner of other similar happy reunions and that we may anticipate an early opportunity of greeting our British colleagues in a similar way in the United States. May this resolution serve as the means of carrying a truly fraternal message of gratitude.

At the same time was voted the following resolution of appreciation and thanks for the generous hospitality extended to the members and guests by Sir Robert Jones:

> To our dear friend and colleague, Sir Robert Jones, we, the American Orthopaedic Association, assembled in Executive Session in the City of London, July 5, 1929, beg to express our grateful thanks for his delightful fraternal courtesy and his open-handed hospitality. We shall ever carry in our hearts the happy recollection of our visit to Liverpool. To his younger colleagues and associates we extend also our grateful appreciation.

Memorials on the deaths of members of the Association during the year—Dr. Clarence L. Starr, Dr. A. Mackenzie Forbes, Dr. Reginald H. Sayre, and Dr. R. Tunstall Taylor—were presented and adopted by the Association.

Five new members of the Association were elected, as follows:

H. Earle Conwell, M.D., Fairfield, Ala.
Rexford L. Diveley, M.D., Kansas City, Mo.
Major Norman T. Kirk, M.D., Manila, Philippine Islands.
Winthrop M. Phelps, M.D., New Haven, Conn.
Edward S. Hatch, M.D., New Orleans, La.

Also as corresponding members:

Dr. Fritz Lange, Munich, Germany.
Dr. Hans Spitzy, Vienna, Austria.

The following officers were elected for the year 1929–1

President: Z. B. Adams, M.D., Boston, Mass.
President-Elect: Willis C. Campbell, M.D., Memphis, Tenn.
Vice-President: A. Bruce Gill, M.D., Philadelphia, Pa.
Secretary: DeForest P. Willard, M.D., Philadelphia, Pa.
Treasurer: John L. Porter, M.D., Evanston, Ill.
Program Committee: Robert Schrock, M.D., Omaha, Nebraska.
Membership Committee: Charles F. Eikenbary, M.D., Seattle, Wash.

Delegates to the American College of Surgeons: John L. Porter, M.D., John P. Lord, M.D., and Fred J. Gaenslen, M.D.

Delegates to Congress of American Physicians and Surgeons: William S. Baer, M.D., with George Bennett, M.D., as alternate.

Many of the members of the American Orthopaedic Association sailed from New York on the Transylvania, on June 22. The Program Committee therefore arranged a Clinical Day in New York on June 21. The clinics were held at The Hospital for the Ruptured and Crippled, and the excellent program arranged gave opportunity for the members to see many interesting cases. On the evening of the same day, the members and guests were entertained by the President, Dr. Fred H. Albee, at a delightful dinner at the Commodore Hotel.

The International Assembly of the Inter-State Postgraduate Medical Association of North America will be held in the new Masonic Temple, Detroit, Mich., October 21 through 25. Information about arrangements for the meeting may be obtained from Dr. Edwin Henes, Jr., Executive Secretary, 445 Milwaukee St., Milwaukee, Wisconsin.

It is with great pleasure that *The Journal* announces with this issue the appointment of Prof. Fritz Lange, of Berlin, as Foreign Editor for Germany.

Prof. Julius Hass of Vienna, who during the past year has served acceptably as a member of the Advisory Editorial Staff of *The Journal*, has been appointed as Foreign Editor for Austria.

Prof. Philipp Erlacher, of Graz, Austria, has been made a member of the Advisory Editorial Staff.

Attention is called to the annual roll call to enroll members of **The American Red Cross** for the year 1930. As usual, the Red Cross will conduct its nation-wide enrollment of members from Armistice Day to Thanksgiving, November 11 to 28.

Dr. Roland O. Meisenbach, recently of Buffalo, N. Y., has moved his offices to 31 Deering St., Portland, Maine.

Dr. Willis K. West and Dr. Charles R. Rountree of Oklahoma City, Okla., announce their partnership in the practice of orthopaedic surgery. Their office is at 508 Medical Arts Building.

The office of Dr. John Joseph Nutt of New York City has been moved to The Medical Arts Building, 57 West 57th Street.

The nineteenth annual **Clinical Congress of the American College of Surgeons** will be held in Chicago, October 14 to 18.

The Annual General Meeting of the **British Orthopaedic Association** will be held in Leeds, on Friday and Saturday, October 18 and 19, 1929. The following provisional program has been arranged:

Friday, October 18

Morning session in the new clinical lecture theatre, The Leeds General Infirmary.

9:30. Annual General Meeting.
Election of officers for 1930–1931.

10:00. Short papers:

Congenital Fracture of the Tibia. Mr. Howard L. Crockatt.
Renal Rickets. Mr. J. R. H. Towers.
Arthritis Arising in Connection with Non-specific Infection of the Urinary Tract. Mr. J. F. Dobson.
And other papers.

2:00. Demonstrations of clinical cases and end results of lesions of the upper limb. By the Orthopaedic Staff.

7:30. Association Dinner at the Queen's Hotel.

Saturday, October 19

At The Leeds General Infirmary.

10:00 Visit to Fracture Department, with discussion on methods of treatment.
Short paper:

Cultures obtained from the Tracts of Pins used in Skeletal Traction in the Treatment of Fractures. Mr. R. Broomhead.

Attention is called again to the announcement by the **Istituto Ortopedico Rizzoli** in Bologna of the competition for the prize Umberto I. This prize of 3500 lire will be assigned, according to the decision of the Provincial Council of Bologna, for "the best orthopaedic work or invention".

Italian and foreign doctors may take part in this competition. The arrangements of the competition and the awarding of the prize are fixed by the regulations which will be sent to whoever asks for them.

Application for the competition should be made to the President of the Rizzoli Institute, Bologna, Italy. The competition will close December 31, 1929.

National Tuberculosis Association. The annual Christmas Seal Sale from November 26 to December 25, 1929, will mark the twenty-fifth anniversary of this organization for the control of tuberculosis. During that period the death rate from this disease has been more than cut in half. However, the present rate of 80.8 per 100,000 population can be still further reduced and the well organized work of this Association must be continued. The annual Christmas Seal Sale offers an opportunity for the public to share in the work of the Association. *Buy Christmas Seals!*

The next meeting of the **Clinical Orthopaedic Society** (Central States) will be held in Milwaukee, Wisconsin, on Friday, October 25, 1929, and in Madison, Wisconsin, on Saturday, October 26, 1929.

Plans for the Fifth Congress of the **Czecho-Slovakian Orthopaedic Society** include papers on the following subjects:

The Place of Amputation. Dr. Zahradníček; Prof. Tobiášek (Prague).
Diseases of the Amputation Stump. Prof. Spišić (Zagreb).
The Treatment of the Diseased Amputation Stump. Dr. Mathieu (Paris).
The Prosthesis of the Lower Extremity. Dr. Minář (Lublaň).
The Disarticulation of the Thigh and Its Prosthesis. Dr. Sorrel (Berck-sur-mer).
The Disarticulation of the Foot and Its Prosthesis. Dr. Sorrel (Berck-sur-mer).
The Prosthesis of the Upper Extremity. Dr. Frejka (Brno).
The Treatment of Spondylitis.
The Presentation of a Table for Orthopaedic Operations. Dr. Galland (Berck-sur-mer).
The Results of Arthrodesis of the Hip in Coxalgia. Dr. Mathieu (Paris).
Traumatic Spondylitis without Fracture of Spine. Dr. Lagrot (Alger).
The Results of Treatment with Plaster-of-Paris.
Table for Orthopaedic Operations. Dr. Ducroquet (Paris).
End Result of Extirpation of Patella after Forty Years. Prof. Levit (Prague).
A Case of Freiberg-Köhler's Disease. Dr. Jaroš (Prague).
Ischiatic Scoliosis.
Luxation of the Radius in Children.
A Case of Osteomyelitic Dislocation of the Hip Healed without Operation. Dr. Neufeld (Bratislava).
The Non-operative and Operative Treatment of Congenital Dislocation of the Hip.
Stabilization Operations of the Foot. Dr. Frejka (Brno).

The meeting was to be held at the Orthopaedic Clinic of the Czecho-Slovakian University in Prague, September 28 and 29. A report of the meeting will appear in the next issue of *The Journal*.

The Editor of *The Journal* was honored with an invitation from the President of the **German Orthopaedic Society** to be present at the Twenty-fourth Congress of that Society, held at Munich, September 16 to 18.

The preliminary program for the Congress includes the following:

The Colloidal Chemistry of the Tissues.

Dr. Schade (Kiel).

Coxa Vara.

Dr. Walter (Münster); Dr. Pitzen (München); Dr. Richter (Leipzig); Dr. Kreuz (Berlin); Dr. Hass (Wien); Dr. Bär (Kassel); Dr. Vischer (Wien); Dr. Scherb (Zürich); Dr. Brandes (Dortmund); Dr. Lindemann (Kiel).

Final Results of the Treatment of Congenital Dislocation of the Hip.

Dr. Max Lange (München); Dr. Spitzy (Wien); Dr. Bade (Hannover); Dr. Schede (Leipzig); Dr. Deutschländer (Hamburg); Dr. Knorr (Heidelberg); Dr. v. Aberle (Wien); Dr. Sudbrack (Leipzig); Dr. Natzler (Mülheim); Dr. Krukenberg (Elberfeld); Dr. Willich (Jena); Dr. Kreuz (Berlin).

Among other demonstrations of special gymnastics, there will be:

Hamburgian Special Gymnastics, Dr. Deutschländer (Hamburg).

(a) Classroom Gymnastics. (b) Foot Gymnastics, Dr. Bettman (Leipzig).

A report of the Congress will be published in the next issue of *The Journal*.

World Conference of Workers for Crippled Children

The first World Conference of Workers for Crippled Children, organized by Edgar F. Allen ("Daddy Allen"), President, and Paul H. King, Vice President, of the International Society for Crippled Children, was held in Geneva under the auspices of the World Federation of Education Associations on July 28–Aug. 2, 1929. The Conference was a success even beyond expectation and demonstrated the active interest in the world in this humanitarian work. Twelve nations were represented by one hundred delegates, including orthopaedic surgeons of prominence, educators, nurses, welfare and lay workers; and telegrams pledging support were received from two other countries, Spain and Poland. The delegates all came with the conviction that such a coordination of interest was necessary and with the desire to find the way in which all could work together. Final harmonious action was taken to make permanent the work done at this time through the International Society for Crippled Children, Inc., of America, and there was evident and also expressed the world-wide vision of all delegates in their desire to eradicate crippledom.

At the final Executive Session the following resolutions(among others) were passed:

Whereas: . . . Resolved by the World Conference of Workers for Crippled Children that we declare:

First: That every cripple has the right to expect of his state or country physical, mental, and social equality.

Second: That assistance to crippled persons is not only a humanitarian but an economic, social responsibility.

Third: That there is a regrettable lack of accurate information as to the number of cripples in many of the countries; that in these, adequate surveys should be made without delay that their results may guide intelligent comprehensive action; and that in all countries where such legislation does not now exist laws be enacted making it compulsory upon the part of physicians, surgeons, midwives, nurses, and teachers to report crippling conditions to the proper authorities.

Fourth: That a great need exists for an adequate number of competent professional workers, both surgical and pedagogical, and that universities throughout the world be urged to create courses, where they do not now exist, for the training of a larger number of orthopaedic surgeons, nurses, and teachers; to provide for compulsory examinations therein; and to establish where not at present existing Chairs in Orthopaedics.

Fifth: That all efforts in the furtherance of the education and vocational training and placement of the crippled should be encouraged and assisted in every possible way, for without education, training, and equipment to fit the cripple to take his place in the world, and without putting him where he can have an equal opportunity, much of the remedial effort is wasted.

Sixth: That responsibility does not end with remedying existing conditions but must extend to preventive work and the practical eradication ultimately of crippledom.

Be it further Resolved, that copies of these resolutions be sent to all known societies engaged in work for the crippled, to the various universities throughout the world, to the Health Departments of the several Governments, to all medical and surgical societies and journals, and to the leading newspapers and general publications.

Whereas: . . . Resolved by the delegates to the World Conference of Workers for Crippled Children now in session in the City of Geneva, Switzerland, and composed of representatives of twelve countries—Great Britain, Sweden, Belgium, the Netherlands, Germany, Czecho-Slovakia, Austria, Hungary, Spain, Switzerland, Canada, and the United States—that we join in an earnest appeal to the League of Nations that the enumeration, treatment, care, education, and vocational training and placement of the crippled, also the prevention of the causes of crippling conditions among children, be made subjects of investigation, study, report and recommendation at the earliest time consistent with pending activities; and that the League of Nations be requested to establish a Department in the Secretariat of the League for the accomplishment of these purposes.

Whereas: . . . Therefore it is Resolved by this Conference that the present Committee on Resolutions be continued as an Executive Committee, with the right of substitution and with the right to coöpt members from other countries to develop such an international plan, and that in the meantime the societies of the several countries represented in the Conference not already members of the International Society for Crippled Children (and any others applying for membership) be admitted as associate members of such Society.

It was agreed to unite the different nations in this International Society and its work; and the twelve nations represented at the Conference, with two others by telegram, have given their support to this development of the International Society.

The following Executive Committee has been appointed:

Dr. Theodore Toepel, Atlanta, Georgia, U.S.A.
Director Hans Würtz, Berlin-Dahlem, Germany.
Henri Leonard Fagel, Utrecht, Holland.
Miss M. F. Shelley Barker, London, England.
Prof. Patrik Haglund, Stockholm, Sweden.
Mr. Edgar F. Allen, President, Elyria, Ohio
Mr. Paul H. King, Vice-President, Detroit, Mich. } ex officio.

The following orthopaedic surgeons have been asked to serve as a Professional Committee on International Relations:

Dr. E. G. Brackett, Boston, Mass., U.S.A.
Sir Robert Jones, Liverpool, England.
Prof. Patrik Haglund, Stockholm, Sweden.
Prof. Konrad Biesalski, Berlin-Dahlem, Germany.
Prof. Riccardo Galeazzi, Milan, Italy.
Dr. Jacques Calvé, Berck-Plage, France.
Prof. Fritz Lange, Munich, Germany.
Dr. Murk Jansen, Leiden, Holland.
Dr. Bedřich Frejka, Brno, Czecho-Slovakia.

CLINICAL CONFERENCE AT THE HOSPITAL FOR RUPTURED AND CRIPPLED, NEW YORK CITY

CONFERENCE OF MARCH 1929

ARTHROPLASTY OF ELBOW FOR BONY ANKYLOSIS.

Dr. Royal Whitman presented the case of an ankylosis of the elbow for which he did an arthroplasty operation. The olecranon was chiseled off in the usual manner, the humerus and ulna were separated with some difficulty, and the head of the radius was excised. The joint was refashioned and was covered with fascia lata which was taken from the patient's thigh. The fascia was sewed in place with chromic catgut sutures, the triceps tendon was resutured to the olecranon, and the wound closed in layers. A plaster-of-Paris bandage was applied, with the forearm flexed to about ninety degrees and midway between supination and pronation.

The result following the operation was satisfactory. When last seen, the patient was able to extend the forearm to about 165 degrees and flex it to about ninety degrees, with about fifteen degrees of pronation and supination. A better final result is expected with physiotherapy treatment as time goes on.

UNUSUAL RESULT FOLLOWING INJECTION OF VARICOSE VEINS

Dr. Ralph Kahle presented a case representing a large varicosity of the internal saphenous vein of the right leg. The vein was unusually large, about three-quarters of an inch in diameter, and very tortuous down past the knee where it had smaller branches extending over the inner side of the calf down to the ankle. The Trendelenberg sign was positive and urine examination negative, hence, an injection of five cubic centimeters of forty per cent. solution of sodium salicylate was given on January 18, 1929. The usual cramp-like pain was complained of immediately following the injection and patient was sent home without a dressing, which had been the usual technique. Two days later the patient returned to the clinic complaining of marked hardening and redness of the vein from the mid-thigh region to the ankle. He stated that he had been unable to sleep a good part of the two previous nights. The examination on that day showed a typical thrombosis, very firm, slightly reddened and tender, with periphlebitis of the tissues from the mid-thigh region to the ankle. From the patient's history, there were no signs or symptoms of emboli following the injection.

He was shown for four reasons:

1. For the very marked thrombosis of the whole internal saphenous vein just below the knee, following one injection.
2. From the standpoint of possible accident of embolus from the upper portion of the saphenous vein in mid-thigh.
3. For the lack of necrosis of the skin and subcutaneous tissues due to such a severe reaction.
4. For the accidental complete obliteration of the whole saphenous vein with one injection, and cured.

AVULSION FRACTURE OF THE CORACOID PROCESS.

Dr. Paul Lapidus presented the case of a colored man about forty years old. Condition occurred during an automobile accident, and there was probably direct injury to the right shoulder. A peculiar point in the present fracture is the outward displacement of the coracoid process as shown by x-ray, while we would expect the coracoid process to be pulled inward and downward by the short head of the biceps, coracobrachialis and pectoralis minor.

Patient had recovered practically without any treatment, except plain immobilization in a sling, and has only slight limitation of abduction. Conditions of that kind are rather uncommon.

Epiphyseal Separation of the Trochanter Minor.

Dr. Paul Lapidus presented the case of a colored boy, about fourteen years of age, who while running felt severe pain in his groin and was hardly able to walk home. He was obliged to stay in bed for a few days, and was seen in the City Hospital.

The most peculiar point was the gait, which showed a deficiency of flexion of the thigh. While walking, in order to flex his thigh, the boy would suddenly swing his body backward so as to throw the thigh forward. This peculiar gait, together with the considerable tenderness which was strictly localized over the smaller trochanter, helped us to make the proper diagnosis before x-ray was taken. The Ludloff's sign in this case was negative, as the patient was unable to lift the heel while lying in the prone position on his back. While sitting he was able to slightly flex his thigh, using as flexors of the thigh, the rectus femoris muscle and the tensor fascia lata and sartorius.

So far, in the literature up to last year, there were reported about forty-five cases, in most of which the diagnosis was not made at all, and the condition accidentally discovered by x-ray.

Longitudinal Fracture of Patella.

Dr. Paul Lapidus presented the case of a white male, about forty-five years of age, who fell on his knees sustaining direct injury to the right patella. The condition was at first mistaken for a sprain of the knee. There was only very slight joint effusion. Motion was free and painless. There was moderate tenderness over the line of the fracture which was, as is shown in x-ray, located over the junction of the medial and outer third in straight longitudinal direction. After several x-rays in oblique direction, the condition was properly diagnosed.

Just a few longitudinal fractures of the patella are reported in the literature. Dr. Lapidus' impression is that that condition is very much more common, but is often undiagnosed. For proper diagnosis, it is important to have an x-ray picture of the patella with knee flexed, and an oblique view with patient lying on his face.

CONFERENCE OF APRIL 1929

Fracture of the Carpal Scaphoid (Two Cases).

Dr. Samuel Kleinberg presented the case of a man sixty-eight years old, who was injured on April 19, 1928. While the patient was leaning with his left hand on the back of a delivery wagon, the driver suddenly started the car backward. The patient's left hand was bent back sharply and he had immediate pain in the wrist. The hand was immediately immobilized. After several weeks, physiotherapy was instituted. The patient did no work at all for three months and since then has been able to do only the lightest form of work. The pain continued and was aggravated by even slight motion in the wrist joint.

Dr. Kleinberg saw him for the first time on December 14, 1928, nearly eight months after the injury. The wrist was moderately swollen, there was radial deviation of the hand and marked sensitiveness to pressure on the radial border of the wrist and the radial half of the anterior and posterior surfaces. The motions were markedly restricted. Flexion was checked at an angle of 150 degrees; extension was completely restricted; forced motion was very painful; rotation of the forearm was painful; motion in the wrist joint was accompanied by crepitus. Flexion of the fingers was restricted and painful.

The x-ray pictures showed an ununited fracture of the scaphoid. An operation was advised because of the persistence of the symptoms. After the removal of the scaphoid, the patient had relief from the pain. He has gradually been getting better. He has a fair range of motion in the wrist, a limited range of motion in the fingers, and decidedly less pain than before the operation.

Case 2. J. A. M., twenty-six years old, fell off a horse on December 30, 1928, injuring the right wrist. He was seen two days after his injury. The right wrist was

markedly swollen and very painful. Pressure on the dorsal surface of the wrist over the scaphoid was very painful. There also was some pain on pressure on the ulnar side of the dorsal surface of the wrist. There was complete restriction of all of the motions.

The x-ray pictures showed a fracture of the scaphoid bone with separation of the fragments and rotation of the medial fragment. There also was a fracture of the cuneiform bone.

In view of the separation of the fragments and rotation of one of them, an immediate operation was decided upon as the best means of giving this patient the most favorable functional result. The operation was performed six days after the injury. The radia fragment of the scaphoid was removed. In trying to loosen the medial fragment, it was by chance brought into what appeared to be normal relation with the radius and was consequently left in place. The wound healed by primary union and the function has steadily improved. On March 29, 1929, a little less than three months after the injury, the patient had no pain. He had full power and motion in his fingers and only slight limitation of motion in the wrist.

These cases are reported because they present several points of interest. When a scaphoid is fractured and the fragments are in normal alignment and in perfect contact, it would appear wise to pursue a conservative course and immobilize the limb with the expectation that the fracture will unite. It is common knowledge that often a fracture of the carpal scaphoid does not unite. If non-union persists for several months, the symptoms of pain and disability may be relieved by removal of the scaphoid. In cases where the fragments are found to be separated, there is no opportunity of approximating them, and consequently an early operation with removal of the scaphoid gives the patient the best prospects for a good functional result.

CONTRACTURES OF NECK FOLLOWING BURNS. OPERATION AND RESULT.

Dr. Fenwick Beekman presented two cases demonstrating the late results in burns of the neck.

The first patient is a boy, fourteen years old, who, three years ago, burned his face, chest, and hands by throwing a lighted match into a can containing gasoline. Immediately thereafter, he was admitted to the Children's Surgical Service at Bellevue Hospital with first and second degree burns of his entire face and both hands. His eyelids and eyebrows and hair over the frontal portion of the scalp were entirely burned off. His eyelids were so swollen that the conjunctival sacs could not be examined. He was treated by means of five per cent. tannic acid ointment to his face and a five per cent. solution to his hands. The skin of the face became well tanned and a month later, when the tanned eschar had completely separated, a clean granulating surface was left on his forehead and left side of the face extending down on to the anterior surface of the neck. This was covered with a hundred full thickness pinch grafts which were removed from the flexor surface of his arm. Later, seventy-four pinch grafts were added. The patient was discharged four months following the accident, with the wound entirely healed.

Today he has a soft scar upon the forehead, left side of the face, and neck. This is freely movable on the underlying subcutaneous tissue and there are no contractures. The scar contains many small circular areas which are lighter than the surrounding skin. These represent the pinch grafts.

Comment: This case is shown as one of burns of the face and neck which was treated by the tannic acid method, followed by early skin grafting which promoted rapid healing of the bare areas before a large amount of granulation tissue was formed, which would have resulted in scar tissue followed by contractures.

The second case is a severe burn of the chin, neck, and anterior surface of the thorax and abdomen which was treated first by the older methods, without early skin-grafting. Later, this necessitated many plastic operations to rid the patient of severe contractures of the neck.

M. M., five years ago, was admitted to the wards of the Children's Surgical Service of Bellevue Hospital for severe burns of the face, neck and body, which she had sustained four months previously, when she was treated in another hospital. She was five years of age on admission. At this time, there was an extensive area of pale granulation tissue covering her chin and anterior surface of the neck and chest. The surface of the wounds was infected and the patient was running a daily temperature varying from 102 to 104. Because of the infection, it was impossible to skin graft this area. The child was removed from the hospital two months later, against advice. A year later, she was readmitted with a marked cicatricial contracture of the scars on the chin, neck, and upper chest. The chin was drawn down to the supersternal notch and there was a marked ectropion of the lower lip. An attempt was made at this time to slide a portion of the skin covering the upper chest on to the neck by making a relaxation incision and undermining the flap. This resulted, however, in failure, as the graft which was placed in the opening on the chest sloughed out. Two years following the burn a second attempt was made, a portion of the scar of the neck being excised and a full thickness Wolff graft sutured into the open wound. This only partly took and the ulcerating area later had to be covered with pinch grafts. A small tube flap was raised over the left shoulder. In August 1927 the patient was again admitted, this was eighteen months later. The thick scar was excised from the middle of the neck, leaving a denuded area two inches in diameter. At the edges of this, four radiating incisions were made, two on each side, one parallel to the body of the jaw and the other running down over the clavicle. Lateral flaps were raised between these incisions and the open area was closed by suturing the one on the left above that on the right, producing a Z-shaped line of closure. This healed kindly. Eight months later the tube flap was opened up, which further relaxed the skin of the neck, and the ectropion of the lower lip was improved by incising through the corners of the mouth and turning the lip inward.

Now the patient can fully extend her neck and the normal outline of chin and cervical region has returned, though the skin covering this region is filled with scar tissue.

Comment: It is felt that if this child had been treated properly from the beginning, many of the operations which she had to later undergo would have been prevented; for if primary skin grafting had been possible, much of the contracture would not have occurred. In operating on this type of contracture, it is important to produce no vertical scars; therefore, the incisions should be planned so that the line of closure will be horizontal or nearly so rather than vertical.

ACUTE HEMATOGENOUS OSTEOMYELITIS OF FEMUR.

Dr. Fenwick Beekman presented a case of acute hematogenous osteomyelitis of the femur in a child, two weeks old.

R. G., male, four weeks old, was admitted to the Children's Surgical Service, Bellevue Hospital, on March 6, 1928, because of a swollen, painful left knee. The mother first noticed this condition two weeks previously, when the baby was two weeks old. Separation of the stump of the umbilical cord was delayed and there was a slight infection about the umbilicus.

On admission, the left knee was found swollen, tense, and held in a partly flexed position. It was tender to the touch and any attempt to move it caused the baby to cry. There were signs of fluid within the knee joint; this was aspirated and ten cubic centimeters of pus evacuated. The culture from the pus was reported as containing staphylococcus aureus. Twenty-four hours following admission, the knee joint was drained by lateral incisions on either side of the patella, the one on the mesial side being carried high up into the quadriceps bursa. A large amount of thick pus was evacuated. The baby was discharged from the hospital two weeks later with the wounds almost healed. The knee joint had full flexion and lacked twenty degrees of complete extension. The x-ray taken a week after admission showed a circumscribed area of rarefaction in the shaft of the femur just above the epiphyseal line.

At this time, April 25, 1929, the child being over a year of age, there is full motion in the knee and there has been no further trouble.

Comment: This case is apparently one of a hematogenous infection of the metaphysis of the lower end of the femur from an infection of the umbilicus. Later the bony lesion perforated the cortex of the femur at the epiphyseal line, infecting the knee joint.

This type of case is seen quite frequently in children, but this case is the youngest child with such a lesion to be admitted to the Children's Surgical Service at Bellevue Hospital.

VARIED LESIONS OF TROCHANTER MAJOR.

Dr. Raymond Lewis presented a small series of x-rays showing varied lesions of the greater trochanter. The series included the following. 1. Pretrochanteric bursitis. Abrupt severe onset in an elderly lady, with a clinical picture suggesting fracture of neck of femur. X-ray showed a shadow in the soft tissues just lateral to the greater trochanter. Treated by diathermy. Symptoms disappeared in a week. Shadow had disappeared in films taken one month after onset. 2. A case thought to represent bursitis and osteitis of greater trochanter, combined. The x-ray showed a small area of bone destruction in the greater trochanter with small calcifications in the overlying soft tissues. The diagnosis was not confirmed by operation, but in another previous case with similar x-ray appearance, the diagnosis was confirmed. 3. A case of simple staphylococcus aureus osteitis of the greater trochanter, subsequently operated upon. 4. A case of osteitis of the greater trochanter coming on during an attack of typhoid, thought to be typhoid osteitis. Subsequently operated upon, but no culture taken. 5. Tuberculosis of greater trochanter and pretrochanteric bursa. History of intermittent pain for five years, much more severe past few months, preventing sleep. X-ray showed a small area of bone destruction in the greater trochanter. At operation an enlarged and thickened bursa was found, with softening of the bone for a depth of three-eighths of an inch. Pathological report: tuberculosis of bone and soft tissue. 6. An undiagnosed case of a large, thick-walled, cyst-like rarefaction in the greater trochanter. Thought to be either a Brodie's abscess or a cyst.

FUSED OS TRIGONUM: OSTEO-ARTHRITIS OF POSTERIOR SUBASTRAGALOID JOINT.

Dr. Arthur Krida presented the case of a man thirty-two years of age who came to the hospital two years previously on account of persistent pain at the back of his right ankle of four years' duration. He had not been able to get relief from various physiotherapeutic measures, nor from braces.

On examination, moderate thickening and tenderness at the back of the ankle were present, together with limitation of motion in the subastragaloid joint. In the lateral view the x-ray disclosed what appeared to be exostoses of the posterior border of the astragalus and of the os calcis, as though the posterior subastragaloid were extended backward. There was some evident roughening at the back of the joint. An x-ray of the left foot showed a similar anatomical arrangement but with no arthritic change.

Operation, March 29, 1927. A five-inch incision along the external border of the tendo Achillis was made. The tendon was divided in a Z-shaped manner, the lower portion of the Z being close to the insertion of the os calcis. Sections of the tendon were then retracted. Areas of cellular-filled tissue at the back of the ankle joint were excised and the exostoses were exposed. It was then seen that the exostoses were lined with cartilage and the edges were rough and irregular. The protruberant mass was chiseled off and the posterior subastragaloid joint exposed. The cartilage was removed from this point, after which the adjacent surfaces of the os calcis and astragalus were roughened and the joint spaces filled with numerous small chips of bone. The tendon was then resutured by kangaroo tendon sutures and the other tissues closed. Plaster-of-Paris dressing with foot at right angle was applied.

Pathology present was an osteo-arthritic change in what appeared to be a fused os trigonum. The plaster was removed after three months. An x-ray showed the posterior subastragaloid to be obliterated.

Two years later he reported for examination. He had been entirely relieved of his pain and was conscious of no disability of the foot. An x-ray showed that consolidation of the joint was complete.

A Report of a Case of Tuberculosis of the Costal Cartilages, Treated by Resection of the Diseased Cartilage and Closure without Drainage.

Dr. Maurice Herzmark presented the case of Miss M. V., seventeen years of age, who was admitted on the First Orthopaedic Service of the Hospital for the Ruptured and Crippled on December 7, 1928. She gave a history of having been perfectly well and normally developed until the age of thirteen when she suffered an attack of pleurisy with effusion. She was treated at her home several weeks, the fluid aspirated from the pleural cavity, and she made good recovery. The attending physician then thought it advisable to remove the patient to the Fordham Hospital for convalescence and x-ray investigation. She was discharged from the hospital entirely well. She resumed her normal pursuits and remained well until two years ago, when she suffered sharp pain in the left chest below the breast, and noticed a swelling in this region about the size of a walnut. The family physician sent the patient to the Memorial Hospital for x-ray examination, which proved to be negative. The physician aspirated the swelling and removed a small quantity of pus. Several days later the abscess recurred. Dr. Lippman was consulted, who aspirated, and instituted treatment with the Alpine lamp. This treatment was continued for six months, without healing the abscess. Dr. Lippman then incised the abscess cavity and drained about one-half ounce of pus. The wound healed, but with the formation of a sinus which continued to drain thin yellowish pus. Occasionally swelling appeared in the original site which when pressed upon caused a flow of pus through the sinus. The patient was referred to the out-patient department of the First Orthopaedic Service of the Hospital for the Ruptured and Crippled.

She was examined on October 2, 1928, by Dr. Kleinberg, who found her in good general condition with a sinus in the region of the costochondral junction of the seventh rib. A few drops of grayish pus could be expressed and some flocculi. A diagnosis of tuberculosis of the underlying ribs was made and x-ray examination advised. X-ray examination by Dr. Lewis on October 3, 1928, gave no evidence of rib destruction or disease. Lungs were negative. Stereoscopic x-ray pictures made on October 8, 1928, with the sinus injected with lipiodol showed the sinus tract lying slightly anterior and superficial to the anterior extremities of the ribs. The location of the disease and history suggested disease of the costal cartilage.

The patient was advised to enter the hospital for excision of the persistent sinus, and on December 10, 1928, the following operation was performed by Dr. Kleinberg: Methylene blue was injected into the sinus. A curved incision about six inches long was made directly under the left breast. The incision extended from the sternum to the anterior axillary line. A vertical incision was then made downward from the middle of the curved incision for a distance of three inches. The sinus tracts were followed out and each one of them was found to have blind ends except one which extended downward towards the ensiform cartilage and led to diseased costal cartilages. The eighth and ninth costal cartilages were found diseased and completely removed. The sinus tracts were curetted and the wound closed without drainage.

The patient made an uneventful recovery and was discharged with the wound practically healed on December 29, 1928. Wound is now completely healed and has remained healed for four months.

A study of the sections removed at the time of operation was made by Dr. Probert on April 19, 1929, and showed that two slides in the group present a definite tubercle formation with definite plasma and mononuclear-cell infiltration and giant-cell formation. Diagnosis: Tuberculosis.

CONFERENCE OF MAY 1929

Case Illustrating Early Operative Treatment of Osteomyelitis.

Dr. Royal Whitman presented a case illustrating early operative treatment of osteomyelitis. The patient, a boy twelve years old, had been operated on for paralytic dislocation of the left hip two years before. Last March he returned to the hospital complaining of severe pain in the right tibia which had persisted for a week or more. The x-ray picture seemed to show some haziness of the marrow at about the middle of the shaft, and there was great sensitiveness to pressure at this point.

An incision was made, the periosteum, which seemed relatively normal, was incised, and four holes bored to the marrow cavity. No pus was present but the pain was immediately relieved. It might be assumed that the osteomyelitis was of a subacute type and that the process was brought to an end by the relief of the local tension.

Case Illustrating Epiphyseal Fracture of the Right Hip.

Dr. Royal Whitman presented the case of epiphyseal fracture of the right hip in a boy fifteen years of age.

There are several forms of this injury, one in which the deformity is great and operative replacement is indicated. In a second class, the displacement is recent; normal relation may be restored by the abduction treatment. This patient belonged to the third class, in which there is but slight and resistant displacement. In such cases the joint should be opened, the head separated and replaced, and an attempt should be made to destroy in part the epiphyseal cartilage attached to the head in order to hasten bony union which would assure stability.

Spondylolisthesis—Operation.

Dr. Ralph Kahle presented the case of Mrs. L. W. The chief complaint of this patient was pain in the lower portion of the back radiating to the inner surface of thighs for about thirteen years. The present illness apparently dates back to about thirteen years ago when she had transient mild pains across the lower portion of the back, which from time to time had grown worse and progressed so markedly that within the past year she had pain upon walking a short distance of one or two blocks. There were also cramp-like pains along the inner side of the thigh, apparently in the region of the bone. Patient has three living children, the last born one year ago. Apparently after this pregnancy the pain became greatly aggravated; she sought relief from her obstetrician, who found no pelvic condition accounting for it.

Past history: Only measles and scarlet fever in childhood, without residues, and tonsillectomy for hypertrophic tonsils in 1926. Family history is irrelevant.

Physical examination showed a well nourished woman, rather short of stature. There seemed to be marked shortening of the trunk, rather mild kyphosis with some flattening of the lumbar region with a typical gutter groove from the sacrum to about the first lumbar vertebra. There is protrusion of what appears to be the spinous process of the fifth lumbar vertebra, rather prominent. There is also a rather mild left lumbar, right dorsal rotary lateral curvature. The spine is freely movable in all directions, but on hyperextension there is pain referred to the lumboscaral region and down apparently in the pelvic area along the iliopsoas muscles to inner side at thighs to the lesser trochanters and femora. Impression was spondylolisthesis. The x-ray showed, in the anterior posterior diameter, a mild rotary lateral curvature to the right in the dorsal and to the left in the lumbar region. The x-ray picture of the fifth lumbar vertebra gives one the impression that one is looking pactically at the fibrocartilaginous surface rather than the anteroposterior view. The transverse process of the fifth lumbar seems to lie forward farther than normal and articulate partly with the upper edge of the ilium. The lateral view of the spine shows a slipping forward of the fifth lumbar upon the sacrum about one-half the width. The sacrum has worn into the posterior half of the fifth lumbar vertebra apparently for a distance of one-half its width in the direction of

the fourth lumbar vertebra. There seems to be some bone shadow along the anterior border of the fifth lumbar and the first sacral vertebra. There is definite displacement forward of the spinous process of the fourth lumbar vertebra as compared with the spinous process of the fifth lumbar vertebra.

Neurological examination by Dr. Klenke is as follows: Patient has involvement of the cauda equina. There is a definite sensory diminution on the left in the fifth lumbar and all the sacral dermatomes. There is the suggestion of a slight hyperaesthesia on the right in the fourth and fifth sacral dermatomes. Impression: Pressure on the roots of the cauda equina due to the bony deformity. There may be also some pressure neuritis.

Operation on April 18, 1929. Under general anaesthesia, a long incision was made, starting about the spinous process of the second lumbar vertebra and running down to about two inches below the uppermost portion of the sacrum. The tissues were divided and periosteum was separated from the spinous processes, the laminae of the lumbar vertebrae, and from the sacrum in the usual manner. A visual examination showed that the arcus of the fifth lumbar vertebra with its spinous process was riding dorsally and was quite well fixed by pressure on the dorsum of the cephalic end of the sacrum. The spinous processes of the second, third, and fourth lumbar vertebrae were on a distinctly anterior level to that of the fifth lumbar spinous process. There was a lack of bony tissue over the lumbar spinous process. There was a lack of bony tissue over the uppermost portion of the sacrum in its mid-line for a distance back of about three-fourths of an inch and about one-half inch wide of spina bifida type. The spinous process of the fifth lumbar vertebra was moved with great difficulty as it was more or less jammed against the top of the sacrum. The articular facets of the third, fourth, and fifth lumbar vertebrae were exposed and the cartilage was destroyed for bony fusion with a chisel. On the left side of the fourth and fifth lumbar vertebrae, a laminectomy was made. Then the distance was measured for a tibial graft and a triangular graft was taken through a long incision on the inner aspect of the right leg. This graft was made triangular to fit over the crest of the sacrum and along the laminae of the fifth, fourth, and third, up to the second lumbar vertebra. It was removed with its periosteum intact. Then chips were thrown down from the spinous process of the lowermost three lumbar vertebrae as well as chips from the sacrum where a groove was made to accommodate the graft on the right side. The wound was then closed in the usual manner with number two chromic catgut approximating the periosteum in its normal relation, the superficial tissues were approximated with continuous plain catgut sutures, and the skin with black silk sutures. The leg wound was closed in a similar manner with plain catgut for the subcutaneous tissue and silk in the skin. Sterile dressing was applied to the back and leg and patient was placed in a previously made posterior plaster-of-Paris shell to accommodate the normal back relations.

On June 13, 1929, patient was discharged wearing a plaster-of-Paris spica applied to the spine as near normal position as possible, after having completed a rest of eighteen weeks in a plaster-of-Paris shell made previous to the operation of the back contour.

The salient features in this case from a diagnostic standpoint are:

1. A traveling lumbosacral joint.
2. Apparent muscle spasm of the iliopsoas muscle.
3. Typical groove of the lumbar back area as described by Dr. R. Whitman.
4. The symptoms of cauda equina pressure.

It is hoped that this patient may be presented in a year's time for study of end result.

Current Literature

DISEASES AND DEFORMITIES OF THE SPINE AND THORAX. By Arthur Steindler, M.D., F.A.C.S. St. Louis, The C. V. Mosby Company, 1929, $12.50.

In his preface the author states that in writing this book "a tendency to dwell broadly upon the basic and theoretic considerations and upon experimental evidence, has come too much, perhaps, into the foreground". To the reviewer it would seem that precisely this tendency constitutes the most enduring and valuable quality of this unusual treatise. All too frequently medical authors are filled with the desire to write a practical, "easily readable" book, "a good seller". Steindler has emphatically rejected this aim. He has set out to develop an "orthopaedic conscience", and he warns the reader in advance that the road he must travel is no easy one. He has tried to develop a coherent story, and in so doing has not hesitated to draw upon all available resources of knowledge, "no matter how far back one may have to turn". That to many a reader who wishes to "get there fast" much of this knowledge will appear irrelevant, is as certain as that to the careful student Steindler's scholarly emphasis on basic principles will help to develop the power of individual judgment.

The scope of the book is broad. It includes not only the three main topics of scoliosis, low-back pain and tuberculosis, but also congenital and static deformities, fractures and dislocations, osteomyelitis, syphilis, arthritis, and tumors. Few orthopaedic surgeons would have the courage to tackle one of these topics, and yet Steindler has covered the ground with an honesty and thoroughness that is admirable. Each chapter is preceded by a synopsis and concluded by a summary or "comment" in which the author with a terseness which is almost epigrammatic drives home his salient points. The literature, not only the American but the English, German, French and Italian, has been reviewed most conscientiously. There are altogether 915 references, which include practically every important contribution up to 1928. When one realizes that many of the articles referred to, such as Farkas' treatise on scoliosis, are lengthy monographs of a highly technical nature, one wonders how in the world a university professor, engaged in active practice, teaching, and research, ever found time to read the works enumerated.

That all orthopaedic surgeons will agree with Steindler's conclusions or even with his method of presentation is not to be expected. Scoliosis and low-back pain, not to mention tuberculosis, offer so many moot questions that no one man can reconcile all conflicts. But the most ardent advocates of fusion operations, and their most ardent opponents, would have to admit that Steindler has presented the case fairly, that his conclusions are well reasoned and the logical outgrowth of his extensive experience.

Of all chapters in the book unquestionably the most difficult and the one most open to debate is that on scoliosis. The author's argument for the form of treatment which he has termed the "compensation method" is based on the fact that the structural element of the scoliotic deformity is not amenable to correction. Since "the only practical and tangible result of forcible correction must be a greatly increased flexibility and collapsibility of the spine", he favors maintaining the rigidity and form of the original curve and developing body symmetry by the formation of appropriate secondary curves. When the compensation so established can be made to hold by means of thorough muscle training and by suitable support, Steindler is opposed to fusion operations; if, however, compensation cannot be established, or if it is impossible to maintain it, then he inclines

to fusion. "It is hoped", he concludes, "that a number of cases now relegated to operative fusion can be brought to more natural physiologic and permanent outcome by compensation methods and by development of a muscle apparatus adequate for the permanent maintenance of body balance".

Although Steindler has warned the reader that "medicine is never light reading", the book holds one's interest and because of its logical sequence offers a real intellectual treat. It adds not only to the high standing of the author but to the scholarship of American Orthopaedic Surgery. Steindler has indeed succeeded in his aim:—to develop orthopaedic judgment.

IMPERATIVE TRAUMATIC SURGERY. By C. R. G. Forrester, M.D., F.A.C.S. New York, Paul B. Hoeber, Inc., 1929, $10.00.

This is essentially a book on industrial surgery. Carefully written, it is obviously the summary of a large experience of traumatic work, fresh and reconstructive. To be commended especially is the careful exposition of splinting, particularly convalescent splinting. The book is full of common sense, and of definite practical suggestions. For example, the clear insistence on proper *forward* position of the arm in shoulder injuries (p. 61) is good teaching, and never so well done before. On the other hand, some of it seems archaic,—for example the consideration of "fibrosis" of the shoulder, ignoring all we know of bursal lesions and tearing of the supraspinatus. So, too, with the matter of Colles' fracture; few will agree with pistol splints, passive motion, and three to four months' total disability, today.

Again, one misses a good deal of the more or less accepted operative technique on fresh and old cases. The reviewer is a conservative in this matter, but today the operative field is a good bit larger than this book would indicate.

To sum up—not perhaps a safe guide always, this book is none the less well worth reading, full of facts and suggestions for the discriminating reader.

One must not forget to add that the illustrations, particularly the masterly pen and ink drawings by the author, are admirable.

GELENKERKRANKUNGEN (JOINT DISEASES). By Ernst Freund, Privatdozent für innere Medizin, Assistent der 1. med. Univ.-Klinik, Wien. Urban & Schwarzenberg, Berlin, 1929.

Orthopaedic monographs on joint diseases are apt to stress treatment and to skip the finer points of classification and differential diagnosis. Here is a reference work which offers no new therapeutic measures, but lacks no detail of etiology, symptomatology, pathology, or general treatment. Freund outlines the classification of all joint diseases and then elaborates with great thoroughness the detailed study of each of the important ones. As an aid to a differential diagnosis, the descriptions and tabulated findings should be of great help.

Such conditions as arthritis alcaptonurica, psoriatica, and posticterica are interesting because of their unusual character. The "American" sacro-iliac subluxation is discussed in a few lines of the one and one-half pages devoted to diseases of that joint.

Many valuable suggestions may be obtained from a chapter on general methods of study. The importance of a detailed history is emphasized and significant laboratory tests given. A general discussion of joint pathology is followed by a detailed study of various types of disease. The infectious arthritides are presented with all subdivisions. The treatment of etiology is exhaustive.

Of especial interest will be a careful study of epiphyseal lesions and aseptic bone necroses, which have been so much discussed recently. Joint disease as a result of endochrine and particularly thyroid disturbance constitutes a little appreciated phase of orthopaedics. Deformities resulting from arthritis deformans are splendidly described, and illustrated by some of the cuts which are generously distributed through the book.

Diseases related to and confused with joint involvement are briefly discussed. Postural defects, peri-arthritis, epicondylitis, snapping joints, and sciatica are some of the most significant.

General therapeutic measures including all varieties of physical therapy are presented in a comprehensive final chapter.

THE TREATMENT OF FRACTURES. By Dr. Lorenz Böhler, Vienna. Translation by M. E. Steinberg, Portland, Oregon. Vienna, Wilhelm Maudrich, 1929.

A notable, a wonderful book! Not in our time has there been anything in this field to compare with it.

When the reviewer reads a book, as he has this, from cover to cover, it is in the nature of an event.

Böhler has gone to the heart of the thing, has challenged our every prejudice, has built up his case on the basis of hard-won personal experience, and, in the main, has "made his case".

One may define him as a radical working on conservative lines, radically.

The opportunity given by the peculiar industrial and political situation in Austria, denied to us—most of us—in our supposedly advanced, but law-ridden country, has given him his chance.

The situation is comparable in a way to that opportunity which Wm. O'Neill Sherman has had in Pittsburgh,—to that which Lambotte had in his time.

Oddly, these others developed the operative field. Böhler is not primarily an operator, but more radical than they.

And here comes our trouble!

Strong meat, and perhaps strong drink, are the best diet, but for strong men only, not for children or even interns.

If Böhler's methods are to be tried out by Dr. X. Y. Smith of Tiverton Four Corners, we shall meet disaster!

Some of us saw the trails of riot, sepsis, and ruin that followed Lorenz, Lane, Albee, after certain tours.

They were right enough; their followers were wrong, because unfit.

So here! Böhler is right, but one may not follow him safely *unless really trained in the game.*

Inter-fragmental anaesthesia, reduction, massage, unpadded plaster fixation; ideal, but absolutely interdicted except to the skilled.

The reviewer has followed Böhler's work a bit; has not seen it, "*leider!*", but has talked with his assistants and with visitors to his clinic. All this stuff rests on *trained skill* of *high grade.*

In the matter of principles, he is curiously clear-headed. To one of the Fracture Committee of the American College of Surgeons, his emphasis on *function, only*, is a delight; and his rejection of the claims of disciples of Bardenhauer, of Lucas de Championnière, and of the modern physiotherapists, is refreshing.

As to operative methods, his stand is a bit grotesque. He cites Henderson and Scudder as to the incidence of pseudarthrosis after open reduction, sixty-six and seventy per cent.

This may be correct. My own figures will run close to ten per cent., and Sherman's will be better than that.

Also, his treatment of pseudarthrosis is archaic.

But this doesn't matter much.

The fact is that he has worked out, in practical detail, methods of treatment, by "closed" methods, of many fractures that we have handled badly, as a rule.

One suspects that his results would compare very favorably with the best we can do in private work.

He has outlined the broad problem admirably.

He has laid down broad principles very clearly.

He has sketched detail treatment well.

He has, however, availed himself of methods we cannot use in America without risk.

That is "our hard luck", not chargeable to Böhler.

Our problem is to take what he has done, to adapt it to our needs, to do conservative work with something like his technique and skill.

That does not mean abandonment of the open operative work, done so well by many of our men, but limitation of such work a little more closely by a bit better development of non-operative procedures.

This means, perforce, a bit more specialization.

Without a doubt we are coming to specialization in accident surgery, industrial and otherwise.

Gladly or not, we must face this problem.

When we have so faced it, we will develop experts, and, in time, some one of them will speak with such authority as the author of this book.

In the meanwhile, I am in favor of having this book interdicted; its sales to practitioners in general absolutely forbidden!

In counterbalance, one must recommend obligatory purchase and study of the book by all bone and joint surgeons, all orthopaedists, all qualified and progressive assistants in these fields.

The Journal wishes to acknowledge the receipt of the following books sent to the Editorial Department:

*Osteomyelitis and Compound Fractures, and Other Infected Wounds. Treatment by the Method of Drainage and Rest. By H. Winnett Orr, M.D., F.A.C.S. St. Louis, The C. V. Mosby Company, 1929.

*Treatment by Manipulation. Ed. 2. By Mr. A. G. Timbrell Fisher, F.R.C.S. New York, The Macmillan Company, 1929.

*Lehrbuch der Orthopädie. Ed. 3. By Dr. Fritz Lange, Geh. Hofrat. Jena, Verlag von Gustav Fischer, 1928.

*Orthopedic Surgery. Ed. 2. By Sir Robert Jones, Bart., K.B.E., C.B., and Robert W. Lovett, M.D., F.A.C.S. New York, William Wood and Company, 1929.

*Die Naht und das Nahtmaterial in der Orthopädie. By Privatdozent Dr. Max Lange. Stuttgart, Verlag von Ferdinand Enke, 1929.

Seventeenth Annual Report, Medical Department, United Fruit Company. New York, 1928.

Bullettino E Atti della Reale Accademia Medica di Roma. Rome, Vol. LV, No. 6, June 1929.

Giornale Medico dell'Ospedale Civile di Venezia. Venezia, Vol. III, No. 3, June 1929.

Slovanský Sbornik Ortopedický. Brno, Czecho-Slovakia, Vol. IV, No. 3, 1929.

Policlínica. Valencia, Vol. XII, No. 9, June 10, 1929.

Svenska Läkaresällskapets Handlingar. Stockholm, Vol. LV, No. 1, 1929.

The Rockefeller Foundation: A Review for 1928. By George E. Vincent. New York, 1929.

The Medical Schools, The University of Chicago. Announcements 1929-1930. Chicago, The University of Chicago Press, June 15, 1929.

*To be reviewed in a later issue of *The Journal*.

ON THE TREATMENT OF FRACTURE-DISLOCATIONS OF THE SHOULDER JOINT WITH SPECIAL REFERENCE TO CAPABILITY OF HEAD-FRAGMENT, DISCONNECTED FROM CAPSULE AND PERIOSTEUM, TO ENTER INTO BONY UNION. Nils Silfverskiöld. *Acta Chir. Scandinavica*, LXIV, 227, 1928.

The results with fracture-dislocation of the shoulder joint are much better following open than closed reductions. A dislocated humeral head which has been completely removed from its capsular or periosteal blood supply is still capable of union with the neck, if accurately replaced. Primary resection of the head is indicated only in cases of extensive comminution or of poor general condition. Satisfactory reposition is usually accomplished only by open operation. This should be resorted to routinely and as soon as possible. Loose pieces should be accurately fitted in place. Immobilization in abduction of eighty degrees and external rotation of forty-five degrees for three weeks or more is followed by supervised active exercises for six months or a year.

Sixteen cases are described and illustrated in support of these facts. A review of the literature shows that attempts at closed reduction are not only dangerous, but are unsuccessful in a large number of cases.—*W. P. Blount, M.D., Milwaukee, Wis.*

PROCEEDINGS OF THE NORTHERN ORTHOPAEDIC ASSOCIATION AT ITS NINTH MEETING IN GOTHENBURG, SWEDEN, JUNE 28, 1927. Edited by P. G. K. Bentzon, *Acta Chir. Scandinavica*, LXIV, 187, 1928.

The meeting was opened by the chairman, Dr. Sv. Johansson, Gothenburg. Harald Nilsonne, Stockholm, and F. Langenskiöld, Helsingfors, each presented a case of bow-leg in which the etiology was unusual. Bone lesions of the proximal tibial epiphyses suggested the type described by Perthes and others. The medial halves of the epiphyses were reduced in thickness and irregular, and in the first case exostoses were present.

Two cases of atypical ossification of the distal end of the femur were presented by R. Hanson and compared as to clinical picture with epiphyseal lesions elsewhere. The diagnosis of tuberculosis which has so often been made in cases of coxa plana was here ruled out. Guildal, Copenhagen, showed two cases of knock-knee due to distal femoral epiphysis lesions. In one, trauma was the cause; in the other, infection.

R. Faltin, Helsingfors, discussed a case exhibiting marked deformity. His diagnosis of rickets was questioned in the discussion, where a similarity to osteitis fibrosa or osteopsathyrosis was pointed out.

The subject of osteotomy in cases of neglected congenital dislocation of the hip was covered by H. Camitz of Gothenburg. He summarized the arguments over priority of method which have occupied the stage since Kirmisson began to do subtrochanteric osteotomies in 1892. The method was rediscovered by Lorenz and von Baeyer in 1918. The former stresses the position of the proximal end of the femur in the acetabulum, while the latter believes that the reestablishment of the function of the hip abductors is the important feature. Schanz does a lower osteotomy and controls the angulation of the femur inward. The pelvis rests against the proximal fragment and stability is restored. Camitz presented four of the twenty-five cases upon which he has operated. Gradual straightening of the angle with return of disability has occurred with all types of operation. In the operation of Lorenz he emphasized the danger of injuring the large blood vessels with the sharp bone end. If the sharp point persists there is danger of ankylosis, and if it disappears one has virtually the result of the Schanz operation. In the discussion, Haglund emphasized the last two points; he agreed with Camitz that the Schanz type of operation was to be preferred.

Haglund discussed, also, the relation of subluxatio coxae (incipient dislocation) to coxa plana. While the latter may be the result of the former in a few cases, Calot's generalization is extreme and should be discarded. The spontaneous reduction of an actual dislocation of the hip is impossible, and where such a phenomenon is reported only a subluxation was present.

Congenital coxa vara was discussed by H. Nilsonne of Stockholm. He considers operative wedge excision to be the only successful corrective measure. The theory of

mechanical causation is untenable and an etiological factor must be recognized in the embryonic defect of ossification.

Robert Hanson presented roentgenological studies of normal and abnormal spines in children. Kj. Bergmann, Malmö, showed two cases of scoliosis with paraplegia. Erik Jenses, Aarhus, demonstrated the "Quengel" method which had been reported by Mommsen. Guildal, Copenhagen, reported lengthening an adult femur five centimeters by oblique osteotomy and skeletal traction.—*W. P. Blount, M.D., Milwaukee, Wis.*

Über die Behandlung der Oppositionslähmung (The Treatment of Opposition Paralysis). H. Camitz. *Acta Chir. Scandinavica*, LXV, 77, 1928.

In cases of paralysis of the opponens pollicis the disability is best overcome by muscle transplantation. The writer avoids sacrificing other thumb muscles by using the palmaris longus. The tendon is isolated and extended by removing with it a strip of the palmar fascia. It is carried through a tunnel under the skin of the thenar eminence and fixed to the first metacarpophalangeal joint. The thumb must be flexed and opposed during the fixation. This position is maintained by plaster for three weeks. Seven cases with good results are reported.—*W. P. Blount, M.D., Milwaukee, Wis.*

Über die Behandlung der traumatischen Epiphyserablösung am Caput femoris (The Treatment of Traumatic Dislocations of the Epiphysis of the Femoral Head). H. Camitz. *Acta Chir. Scandinavica*, LXV, 82, 1928.

From a study of four cases and a review of the literature, the writer concludes that in very early cases of dislocation of the proximal femoral epiphysis, reposition is possible by gentle abduction and inward rotation of the extremity. When the blood supply to the epiphysis has not been too greatly disturbed, the prognosis is good. In cases with marked displacement, it is bad.

In cases of long standing, bloodless reposition is never attempted. This method has frequently resulted in injury to the head of the femur, the capsule, the muscles, or the blood supply, with increase in the disability. When good function is possible with the extremity in outward rotation, as is often the case, the hip is left undisturbed and the lower portion of the femur rotated into the desired position by a transverse osteotomy. —*W. P. Blount, M.D., Milwaukee, Wis.*

Calcinosis Intervertebralis. L. P. Rietema and S. Keijser. *Acta Radiol.* IX, 606, 1928.

The authors report two cases of calcification of a normally thick intervertebral disc which caused symptoms which might easily be confused with spondylitis or sciatica. Unilateral limb pain, hyperaesthesia, and atrophy were present. No direct nerve tenderness was elicited. Reflexes were diminished. There was locally a scoliosis and tenderness over the spinous processes. The x-ray in the first case showed a calcified area in the disc between the tenth and eleventh dorsal vertebrae, lying a trifle ventrally from the axis of the body and of a slightly ring-shape. There was nothing to suggest tuberculosis. In the second case the deposit lay between the eight and ninth dorsal vertebrae, extending throughout almost the whole disc. Bed rest for a short period relieved both patients of symptoms.

A review of the literature reveals only four additional cases, in one of which the calcification eventually disappeared spontaneously.

The etiology of the condition is not known.—*J. E. Milgram, M.D., Iowa City, Iowa.*

Fat in Traumatic Effusions of the Knee Joint. David H. Kling. *Am. J. Surg.*, VI, 71, Jan. 1929.

Fat is found in effusions in the knee joint only when blood is also present. It was found in thirty-nine and six-tenths per cent. of fifteen cases studied. The finding of fat in knee fluids is evidence of severe injury and indicates fracture of articular surfaces

or tearing of synovia which is usually accompanied by ruptures of ligaments and dislocation of semilunar cartilages.

Aspiration is beneficial from a therapeutic standpoint as well as for diagnosis and prognosis. Fibrin and fat are absorbed slowly and may be responsible for the formation of loose bodies.—*W. E. Grieve, M.D., Iowa City, Iowa.*

Bilateral Snapping Hip. Arthur M. Dickinson. *Am. J. Surg.*, VI, 97, Jan. 1929.

Dr. Dickinson discusses snapping hip from the standpoint of etiology and treatment. He reports a case of bilateral snapping hip on which he operated twice on both sides. At the first operation, done under general anaesthesia, the iliotibial bands were cut. At the second operation, done under local anaesthesia, both the iliotibial bands and the anterior border of the gluteus maximus were divided. Six months after the final operation the results seemed good.

Operations should be done under local anaesthesia so as to see the cause of the snapping, as the tight band relaxes under general anaesthesia. The postoperative immobilization should be short.—*W. E. Grieve, M.D., Iowa City, Iowa.*

Extra-articular Arthrodesis of the Hip for Tuberculosis. F. H. Albee. *Ann. Surg.*, LXXXIX, 404, Mar. 1929.

A double autogenous bone-graft bridge, extending from the great trochanter to the side of ilium, is used. Thirty-one cases operated upon with "very satisfactory clinical and functional results in all cases". Four different techniques are described. Depending upon conditions found, the bone graft is sometimes taken from the trochanter, sometimes from the side of the ilium, and, in cases of marked destruction, the trochanter itself is grafted to the side of the ilium. Eight cases are reported in detail. In one case an arthroplasty of the hip was performed four years after the arthrodesis, and very good motion obtained.—*Fred G. Hodgson, M.D., Atlanta, Ga.*

Astragalectomy for Fractures of the Astragalus. W. T. Graham and D. M. Faulkner. *Ann. Surg.*, LXXXIX, 435, March 1929.

The authors report the results of ten cases of astragalectomy following fractures of the astragalus. They conclude:

1. Fractures of the astragalus rank with fractures of the os calcis in resultant disability.

2. As the best result from removal of the astragalus is usually rated as giving twenty-five per cent. disability of the extremity, open reduction should be resorted to in more instances, thereby eliminating many late astragalectomies.

3. If the reduction obtained by open operation cannot be maintained, or if the comminution and crushing of the bone is very severe, early astragalectomy is indicated.

4. In late cases of malunion and of non-union, astragalectomy is the treatment of choice.—*C. H. Lowendorf, M.D., Iowa City, Iowa.*

Astragalo-scaphoid Dislocation. H. Milch. *Ann. Surg.*, LXXXIX, 427, Mar. 1929.

The author reports the thirteenth case and reviews the literature on the subject. The patient fell five feet, turned his foot, and had a great deal of pain. Stereo x-rays showed the forefoot moderately inverted and adducted. The head of the astragalus was dislocated up and out and rode over the cuboid. On physical examination the foot was in varus position and all bony landmarks gone except the external malleolus. The head of the astragalus was palpable beneath the skin, pointing up and out. A deep depression was felt in the site of its normal position. Under anaesthesia, with the ankle and hind foot fixed, the forefoot was plantar-flexed, adducted, and inverted. With a snap the reduction occurred.

A cast was applied holding the foot in valgus position and at right angles. After two weeks the x-ray showed recurrence. Following the second reduction the foot was put in extreme flat-foot position and a pressure pad placed over the astragalus. Cast was then applied. X-rays showed reduction and mild arthritis. Physiotherapy was started in three weeks. A month later patient could use foot freely and without discomfort.—*C. S. Lowendorf, M.D., Iowa City, Iowa.*

Osteomyelitis of the Vertebrae. A. O. Wilensky. *Ann. Surg.*, LXXXIX, 731, May 1929.

This is a continuation of the article begun in the April number of Annals of Surgery. It is a very complete and comprehensive article. The symptoms of osteomyelitis of the vertebra are very much like those of osteomyelitis elsewhere. The location of the abscess in the bone makes diagnosis often difficult. The abscess spreads in various directions depending upon its location in the vertebra, those in the body going foward, those in the neural arch going toward the back. Many and various complications arise; often the diagnosis is not made except at autopsy. Illustrative cases are reported. Abscesses which encroach upon the spinal canal give various and often obscure neurological symptoms. The mortality of vertebral osteomyelitis is very high, varying from thirty-three to seventy-one per cent., depending upon its location. Treatment must vary, depending upon the location of the abscess.—*Fred G. Hodgson, M.D., Atlanta, Ga.*

Carpal Osteitis. H. C. Blair. *Ann. Surg.* LXXXIX, 748, May 1929.

Eight cases are presented. The scaphoid and semilunare were most frequently involved. Buchman has reported seven cases of this disease and calls it osteoporosis of the carpal bones. Symptoms are pain, swelling, stiffness over the involved bone. Treatment consists of diathermy and immobilization. The x-ray findings showing cavity formation are characteristic.—*Fred G. Hodgson, M.D., Atlanta, Ga.*

Fracture of the Carpal Scaphoid. R. V. Grace. *Ann. Surg.*, LXXXIX, 752, May 1929.

Seventeen cases with follow-up results are reported. There were eight acute, and nine chronic cases. Acute cases were immobilized in plaster from fingers to elbow, wrist in dorsal flexion, thumb abducted; maintained six to eight weeks, followed by physiotherapy. Three cases obtained union and normal function; three cases were ununited but very little if any disability persisted. One case had twenty-five per cent. disability. Of the chronic cases, four were operative and five non-operative. Three operated cases where the entire bone was removed had complete relief of pain but function was not much improved. Removal of only a fragment of the bone did not give so satisfactory a result.—*Fred G. Hodgson, M.D., Atlanta, Ga.*

High Vein Ligation in Thrombo-Angiitis Obliterans. G. W. Van Gorder. *Ann. Surg.*, XC, 88, July 1929.

Production of adequate collateral circulation is the chief aim of treatment. The author ligates the external iliac vein to impede the return circulation. Nine very interesting cases are reported giving the results of operation. There was definite improvement in three cases following ligation of the femoral vein, and marked improvement in four cases following ligation of the external iliac vein. The author's final conclusion is that of all forms of conservative treatment employed in this clinic in China for thromboangiitis obliterans, high ligation of the veins appears to be by far the most promising. —*Fred G. Hodgson, M.D., Atlanta, Ga.*

Operative oder konservative Behandlung der Knietuberkulose? (Operative or Conservative Treatment of Knee Tuberculosis). O. Jüngling, *Arch. f. klin. Chir.*, CLII, 541, 1928.

The author bases his experience upon 117 cases of knee joint tuberculosis treated from 1917 to 1923.

He comes to the following conclusions: first, he differentiates strictly in cases of clinical tuberculosis of the knee joint and between cases of hydrops and those of fungus. He points out that it is doubtful whether hydrops cases are always knee tuberculosis. As far as the tuberculosis is concerned, a distinction should be made between the cases of children and adults.

The conservative treatment was carried out in all phases of cases in initial stages, and consisted in x-ray treatment, rest, immobilization, and heliotherapy. Of the 117 conservatively treated cases at Perthes' clinic in Tubingen which are reported in this paper and which have been followed up for three to four years after discharge, he found that the hydrops tuberculosis in children healed in a frequency of 88.9 per cent., and in adults in 84.2 per cent. with full mobility. The fungus form healed in children in 82 per cent., and in adults in only 29 per cent., and only half of these cases healed with mobility. Of the adults, 14.5 per cent. died during the treatment, and of the remaining percentage not healing, most of them got gradually worse and finally had to be resected (75 per cent.), or amputated (25 per cent.). 61.9 per cent. of the resected cases had healed primarily; in 14.3 per cent., sinuses developed; and in 23.8 per cent. an amputation was finally necessary. The author computes the loss in time occasioned by the conservative treatment in these cases at more than two years. All in all, in children under fourteen there were nine hydrops cases and thirty-four fungus, while in juveniles and adults there were nineteen hydrops and fifty-five fungus cases.

The author points to the advantage of heliotherapy and deep x-ray therapy and states also that in the adults even these have not improved the results of conservative treatment; that in adults the method of choice is a resection. In children there is in all cases of hydrops an indication of conservative treatment, including x-ray therapy. —*A. Steindler, M.D., Iowa City, Iowa.*

VERSUCHE ÜBER DECKUNG VON PATELLARKNORPELDEFEKTEN MITTELS GELENKKAPSEL (Experiments on Covering of Defects of the Patellar Cartilage with Joint Capsule). S. Hoffheinz. *Arch. f. klin. Chir.*, CLII, 557, 1928

This is a question which is of the greatest interest for the knowledge of biological changes in arthroplasty. The author has investigated the fate of joint capsule covering experimental defects of the patella. The experiments were carried out on dogs and rabbits. On the basis of these findings he comes to the following conclusions: autoplastically transplanted joint capsule heals in the dog with great regularity, while in the rabbit it is the exception. Regenerative changes occur in the transplanted tissue after a short period of degenerative changes, but even these regenerative changes never lead to a production of normal joint capsular tissue. Even under the most favorable conditions, only a connective tissue or fibrocartilaginous scar with narrow synovial covering is formed. Hyaline cartilage, however, is not developed, at least not up to 148 days of the observations. It is only found in very small islands on the surface of such places as are subject to abnormal compression or stress. So one may assume, in applying his experiences to conditions operatively obtained in arthroplasty, that even the substitution of cartilage tissue by capsular tissue remains a makeshift, and such tissue cannot be distinguished in its final condition from other types of interposition material,—for instance, fat, fascia, muscle, and peritoneal. Yet one may say that, although cartilage formation is not forthcoming from a transplantation of synovial tissue, yet there is a certain advantage in the use of the latter; and that lies in the fact that it is capable of regenerating rapidly even though a good deal of necrosis of the transplanted tissue may occur,—that is, in the first day after transplantation. Practically, it is probably only the patella which would come into consideration for the application and use of joint synovial tissue.—*A. Steindler, M.D., Iowa City, Iowa.*

Über den Verlauf der sogenannten Osteitis (Osteodystrophia) fibrosa localisata (The Course of the So Called Osteitis Fibrosa Localisata Osteodystrophia). C. T. Willich. *Arch. f. klin. Chir.*, CLII, 582, 1928.

Twenty-three cases are reported; of these the femur was involved eight times, tibia five times, mandible six times, and humerus, ulna, fibula, and maxilla each once. Thirteen of the twenty-three cases were from eleven to twenty years old, the other ten from twenty to fifty years old.

Progressive bone atrophy is the first stage. The original opinion of Recklinghausen that a generalized osteitis fibrosa develops only upon the basis of an osteomalacia, or rickets, is no longer generally acknowledged. At least, Schmorl found concurrence of osteitis fibrosa and osteoid tissue as a sign of osteomalacia only eight times in forty-four cases.

Still less is known of the initial stage of the localized and circumscribed cyst. Here the histological findings would indicate that the initial stages are also of fibro-osteo dystrophy, but one must recognize the fact that the same histological findings which are encountered in the typical brown resorption tumors of this condition are also found in pseudarthrosis, endosteal hematoma, and at the borders of osteomyelitic foci.

As far as the extension of this cyst in the long type bone is concerned, Frangeheim points out that the epiphyseal line always arrests its progress, and the observation of Sauer of a case in which the cyst penetrated into the epiphysis of the humerus is a rare exception. The author, however, found three cases in which the cyst penetrated from the metaphyses to the epiphyses.

As far as the cure of the cystic degeneration of the bone is concerned, the author is of the opinion that a moderate surgical interference, consisting in the opening of the bone and extensive curetting, is to be preferred to other methods, especially the x-ray treatment, and that the operation will end the painful and progressive condition. The thorough evacuation of a small focus of osteitis fibrosa in the initial state produced cure in three cases observed from three to eight years afterward. The cleaning out of a cyst of a brown tumor produced in nine cases complete cessation of the subjective symptoms, and in four of these cure was established by x-ray examination; in the other five cases the process is no longer progressive, but is at least stationary and partly regressive. Three cases required several curettages, and one case resisted curettage and finally came to amputation.

The author concludes from his experiments with a material of twenty-three cases that the operative removal of the focus is the method of choice, especially because of its very favorable effect upon the subjective symptoms. Resection or extirpation of the whole bone in suspicious cases (malignancy), and especially in cases of recurrences, should be carried out.—*A. Steindler, M.D., Iowa City, Iowa.*

Über die Osteodystrophia fibrosa (O.F.) und ihre Beziehungen zum Sarkom (On Osteodystrophia Fibrosa and its Relation to Sarcoma). A. Fromme. *Arch. f. klin. Chir.*, CLII, 601, 1928.

This author points to osteodystrophia fibrosa as a frequent and not, as formerly supposed, a rare disease of the skeletal system. Schmorl found it in two and seventy-five one-hundredths per cent. of the cases among 650 cases of systematic investigations of the skeletal system. In the last six years Fromme found no less than twenty-four cases of osteodystrophia fibrosa. He likewise comes to the conclusion that, according to his material, not a single case came to cure without operation; all non-operated cases retained subjective complaints. The extremity is less used functionally, there is muscle shrinkage, and the x-ray shows all the typical changes of the osteochondritis fibrosa. Bergmann, reporting from Hildebrand's clinic, also comes to the conclusion that no case heals without operation. On the other hand, the course of the operative cases is very much more favorable. Six cases are reported.

Observations of the author show not only the difficulties of the clinical differential diagnosis between this condition and sarcoma, from the x-ray point of view, but also

the fact that differential diagnosis is extremely difficult even under the microscope. The microscopic findings after exploratory incision are so difficult of interpretation that different diagnoses obtained from different pathologists are the rule. Observations further show that the osteitis fibrosa has close histo-biological relations to the sarcoma. In making the indication for its surgical intervention, one should always reckon with the possibility of so called presarcomatous condition. When conservative surgical intervention is applied, which consists in the opening of the bone and the curettage of the cyst, strict roentgenological supervision must follow. Furthermore, there will be many cases of doubt in which a more radical surgical procedure has to be considered. The author reports two cases, one of a man thirty-one years old showing a gross subtrochanteric cavity in the thigh. The operative impression was cystitis fibrosa; microscopic, osteomyelitic fibrosa. After two years, true sarcoma developed. In another case of a man, thirty-eight years old, there was spontaneous fracture of the surgical neck of the humerus; diagnosis, osteodystrophia fibrosa. After ten years there was a renewal of pain in the arm and an operative procedure was instituted consisting in opening and curettage. Histological diagnosis (Schmorl): osteodystrophia fibrosa. The clinical course responded to this diagnosis for two years; then, however, the patient again complained of pain in the shoulder; an x-ray showed that the osteitis fibrosa had not healed, but that there were no findings indicating malignancy degeneration. Another operation was performed and again diagnosis of osteitis fibrosa (Schmorl) was made. After a few weeks nodes appeared in the scar and exploratory incision gave histological findings of true sarcoma. Exarticulation of the humerus was done but the patient succumbed very shortly afterwards with metastasis in the lung.—*A. Steindler, M.D., Iowa City, Iowa.*

ZUR KENNTNIS DER WIRBELKÖRPEREPIPHYSE UND DER AN IHR VORKOMMENDEN VERLETZUNGEN (The Epiphysis of the Vertebral Bodies and its Injuries). G. Schmorl. *Arch. f. klin. Chir.*, CLIII, 35, 1928.

While the older statements assume that the epiphyses in the vertebral bodies appear first in the thirteenth year of life, the author's newer findings have shown that in girls they appear as early as in the eighth year. The anatomical investigations show the epiphyses as red spongious foci placed parallel to the contours of the body and separated from it by free zones of cartilage substance. He believes that the epiphyses develop dis-continually,—*i.e.*, in sections. He never found it earlier than the eighth year, and then only in females. In boys it was first found in the thirteenth year. He reports two cases which show changes of the vertebral epiphysis: one showed a circumscribed tuberculosis of the epiphysis; the other case, an injury involving the seventh to the ninth intervertebral discs, in a sixteen-year-old girl. A further series of cases of injury to the epiphyseal disc and the adjacent portions of the vertebral bodies are reported. In one case there was found a detachment of the upper margin of the eleventh dorsal vertebra; in the same individual the twelfth dorsal vertebra showed radial lines at the under surface, which are regularly found in juvenile vertebrae where the growth is not entirely completed. In the same patient he found the small cartilage node which is seen frequently in juvenile vertebrae, as a remnant of the growth period. It is possible that this cartilage node assumes a pathological importance in cases of trauma, as Schanz is inclined to believe.

Another interesting case of injury to the vertebral disc and adjacent portions of the vertebral body is reported in a twenty-year-old girl who died of pyaemia and who, four years prior, had received an injury by falling from a wagon. In this case the upper anterior margin of the third lumbar vertebra showed a healed marginal fracture together with a tear of the intervertebral disc. In another specimen there was found an ununited fracture of the anterior vertebral ledge involving the upper edge of the fifth lumbar vertebra, and separated by a small fissure from the rest of the vertebral body. The fissure reached into the intervertebral disc.

Another interesting case reported is that of a thirty-six-year-old man. In this case the tenth intervertebral disc was missing in its anterior half, and there existed a bony

fusion between the ninth and tenth vertebrae; the dorsal half of the intervertebral disc containing the nucleus pulposus was preserved. This type of defect can be attributed either to a disease or to traumatic influence. Ossification of the intervertebral disc is not very uncommon; it starts from the region of the nucleus and finally involves the entire fibrillary portion of the disc, leaving the nucleus pulposus intact. In the case described the author inclines towards the supposition of a traumatic influence as being responsible for the premature fusion of the two vertebrae. This was substantiated by the statement that ten years before death the patient had received a severe injury which caused him to be bed-fast for three weeks, and had produced violent pain in the back. —*A. Steindler, M.D., Iowa City, Iowa.*

Ricerche sperimentali sulle Osteodistrofie (Experimental Investigation on Osteodystrophia). R. Rizzi. *Arch. di Ortop.*, XLIV, 716, 1928.

The author comes to the following conclusions: the osteitis fibrosa, which recently is being named osteodystrophia, is not to be considered a true and definite morphological entity, but rather represents a pathological picture due to a diversity of etiological causes. It is characterized by a precipitate restitution of bone, by a disorder or a disarrangement of the trabecular structure, by lacunar absorption, by apposition of new bone, and by a fibrous transformation of the medulla.

The syndrome may be present in several conditions due to different causes, as has been demonstrated by iate clinical and experimental contributions. Nerve lesions, either of central or peripheral origin, are not sufficient to produce directly the alteration typical for fibrous osteodystrophy. Neither are lesions of the sympathetic nervous system in themselves sufficient to produce similar pathological changes.

The author also concludes from his experiments that the presence of germs in the osseous tissue is likewise insufficient in itself to produce fibrous osteodystrophy, and that it was not possible to demonstrate specific germs which have the ability of causing the pathological changes described.

In order to produce the syndrome of osteodystrophia fibrosa, it is necessary to have the influence of abnormal stimuli, which in some way disturb the common defense mechanisms of the tissues, and act directly upon tissue element, the latter reacting in a manner entirely specific and not comparable to the reaction present in inflammatory osteomyelitic conditions. Such abnormal stimuli may be considered chronic traumatic influences. These are capable of producing the syndrome of osteodystrophia, provided they are associated with specific conditions of the tissues, for instance, circulatory disturbances, or the presence of toxic substances.

These conclusions were reached by experimentations on rabbits. The effect of nervous disturbances was studied by producing lesions of the sciatic nerve. The effect of inflammatory conditions was studied by producing chronic ulceration of the calcaneus. The effect of the disturbances of the sympathetic nervous system was studied by extirpation of the superior cervical ganglion.—*A. Steindler, M.D., Iowa City, Iowa.*

Considerazioni su 170 Casi di Fratture del Bacino (Consideration of 170 Cases of Fracture of the Pelvis). E. Ettorre. *Arch. di Ortop.*, XLIV, 587, 1928.

Among a total of 6,998 fractures treated during eight years in three surgical departments of the Ospedale Maggiore of Milan, there were 167 fractures of the pelvis, or two and thirty-eight one-hundredths per cent. This percentage is higher than that given in the statistics of other authors. Ettorre divides the cases into partial and total interruptions of the pelvic ring. Among the partial the distribution was as follows:

Fracture of the pubic branches, six cases, or 3.52 per cent.

Fracture of the os ischii, seven cases, or 4.11 per cent.

Fracture of the iliac wing, forty-one cases, or 34.11 per cent.

Fracture of the acetabular roof or limbus, one case, or 0.58 per cent.

Transverse fractures of the sacrum, six cases, or 3.52 per cent.

In 111 cases, or 65.3 per cent., there was complete interruption of the pelvic ring as follows:

Thirty-three cases fracture of the anterior arc of the ring, or 14.41 per cent.

Six cases unilateral fracture of the posterior ring, or 3.52 per cent.

Forty-one double vertical fractures, or 24.11 per cent.

Thirty-one cases of fracture of the acetabulum, or 18.23 per cent.

In ninety-two cases, or 54.11 per cent., the fracture of the pelvis was due to fall; in thirty-seven cases, or 21.76 per cent., it was due to crushing; in fourteen cases, or 23.52 per cent., to contusion; and in only one case to muscle action. Brick-layers furnished the greater contingent of the injured.

The period of disability varied from a few days to eight months, being an average of four to five weeks.

The usual conceptions concerning the mechanism of the various fractures as they have been developed from cadaver experiments were not always confirmed by the history of the cases. One must always take into account not only direction and size of the force but also the amount of inertia, depending upon the mass of the body, eventual brisk movements of defense, and finally the progressively traumatizing force which becomes active once the resistance is overcome. Isolated fractures by indirect action are rare. Especially fractures of the os ischium, pubic branch, and partial diastasis of the synchondrosis, accompanied by small osteoperiosteal detachments, are likely to escape attention, and often radiographic examination carried out much later reveals the presence of reparative processes in places which were not suspected of fracture at the original examination. The diastasis of the symphysis cannot be determined without simultaneous interruption of the posterior ring, or at least a diastasis of the posterior synchondrosis. It effects a disjunction of the articulations which is as disabling as a fracture. Fractures occur with preference in the neighborhood of the iliopectineal tubercle of the tuberosity, and posteriorly near the synchondrosis. The sacrum sustains relatively easily fractures from crushing, which are, on the whole, similar to those seen in the vertebral bodies. The tuber os ischii may become detached following direct trauma.

The prognosis of partial fractures on the whole is good. The prognosis of the complete fractures, or total fractures, varies greatly according to the degree of displacement. Later observations showed that the most serious disabilities result from the double vertical and comminuted fractures of the posterior ring as well as from the fracture of the acetabulum and penetration of the femoral head into the pelvic ring.

In many cases the treatment is limited to bed rest and eventual compressive bandage. In other cases where complications arise and where the degree of displacement is great, intervention becomes necessary. In transverse fractures of the sacrum one should try the alignment under anaesthesia through the rectum, and in double vertical fractures with displacement of one side of the pelvis, strong and progressive traction and countertraction must be done.

In fractures of the acetabulum one should proceed with a reduction by combined manoeuvers. In all cases it is important to maintain a correct position by permanent and efficient traction directly applied to the skeleton. As in all fractures, reduction should be carried out at the earliest possible moment. Weight-bearing should not be permitted until the x-ray picture reveals complete consolidation of the fragments.

The most frequent complications are those of the urinary system, reflex retention, or essential hematuria according to the degree of contusion suffered by the kidney. Rupture of the urinary tract (urethra) is of severe prognosis and requires, from the beginning, energetic surgical intervention. It is less frequent than it was considered in the past when the diagnosis of pelvic fracture was less established. A permanent catheter should not be applied except in special and particular cases.

The prognosis depends, aside from shock and fat embolism, upon the visceral lesions. The abdominal organs must be very closely supervised, since lesions may occur requiring immediate surgical intervention.—*A. Steindler, M.D., Iowa City, Iowa.*

L'Assenza congenita del Femore (Congenital Absence of the Femur). A. G. Chiariello and P. Ibos (Paris). *Arch. di Ortop.*, XLIV, 891, 1928.

Two cases are reported. Conclusions: total and definite absence of the femur is exceptional; partial, however, is not infrequent. According to the classification of Potel it belongs to localized bone dystrophy. Congenital coxa vara may be considered as a variety of the congenital absence of the femur. This condition is of embryonal origin. The x-ray is indispensable for the determination of the malformation and the study of its later development.

Often such malformations can be sufficiently corrected by a prosthetic apparatus. —*A. Steindler, M.D., Iowa City, Iowa.*

L'Epicondilite dell'Omero (Epicondylitis of the Humerus). V. Ferrero. *Arch. di Ortop.*, XLIV, 740, 1928.

The author is convinced that the apparent rarity of cases of epicondylitis of the humerus is not real, but depends rather on a number of determining factors, among which the most important seems to be the different distributions of force activities in the different countries, together with the different exposures to activities which favor the occurrence of this injury,—as, for instance, tennis.

However, there are a number of occupations which may produce this injury. In the literature are reports of injury occurring among artisans, violin players, dancing masters, etc.

The condition usually appears after prolonged and constant exercise which requires of the elbow continuous movement of flexion associated with pronation and supination. The pathological lesions involve bone and periosteum, and the author insists that the lesions, therefore, may be brought to light by x-ray examination comparatively early, contrary to the opinions of most authors, who point out that in recent cases no pathological lesions can be found. In all cases reported by the author the lesions were distinctly visible as early as from one to three months after the appearance of painful symptoms.

The x-ray evidence is described as follows: the humeral epiphysis over a distance of two or three centimeters about the tip of the epicondyle presents an irregularity and haziness of the cortical line. Below this contour one sees for a depth of three to four centimeters irregular trabeculation and decalcification, which blends into a distinct rarefying osteitis. At the level of the epicondyle one sees periosteal proliferation in the anteroposterior picture. In the lateral picture one also notes the periosteal proliferation which extends to the anterior surface of the condyle even into the articulations.

On the basis of his observations the author considered the prognosis not particularly favorable, since one has to deal with the disease which has a long and protracted course and which imposes upon the patient a long period of rest. The second point which impairs the prognosis is that the lesions are extended into the humero-radial articulations and cause an arthritis which usually becomes chronic and develops into a truly deforming type. For this reason the author believes that one should not be too optimistic about the prognosis. Above all things one must insist upon immobilization and rest for the limb, then upon warm baths daily, and upon diathermy.

The course of the disease is rather long, and even most painstaking treatment will only relatively shorten the time of disability. The author is not in a position to give an opinion as to surgical intervention.—*A. Steindler, M.D., Iowa City, Iowa.*

Della Cura e dell'Esito della Tubercolosi del Ginocchio (Treatment and Results in Tuberculosis of the Knee). G. Giuliani. *Arch. di Ortop.*, XLIV, 769, 1928.

Report of twenty-five patients, children as well as adults, aged from nine to fifty-five years. Twelve children and thirteen adults. The author comes to the following conclusions: in tuberculous hydrops, immobilization is the treatment of choice in adults

as well as in children. In the fungus osteo-arthritis of the adult, the operation is the arthrectomy followed by arthrodesis with good bony ankylosis. In some cases the excochleation—curettage of the condyle—is distinct, and limited tuberculous foci may be removed.

In the adult, an economic resection is always to be carried out in cases of white swelling not influenced by immobilizing treatment. After arthrectomy, as well as arthrodesis (an economic resection), the limb must be maintained in a plaster-of-Paris cast for not less than six months in order to give time for an infection to abate and ankylosis to become accomplished.

Amputation is carried out in cases where the knee represents a bad posterior dislocation; and in cases with numerous ramified sinuses as well as in extensive deep lesions of the articulation itself.—*A. Steindler, M.D., Iowa City, Iowa.*

ARTRORISI POSTERIORE DELL'ARTICOLAZIONE TIBIO-TARSICA (Posterior Arthrorisis of the Tibiotarsal Articulation). R. Micotti. *Arch. di Ortop.*, XLIV, 878, 1928.

The operation described is that of Campbell, who produced a posterior block in the tibiotarsal articulation with slight modifications. The principal point consists in that the author uses the third metatarsus in vertical direction implanted in vertical direction into the calcaneus as block against plantar flexion. He reports two cases, the x-ray pictures showing the permanence of the implants. These two cases with the so called "arthrorisis" effected by disarticulation and implantation of the metatarsus, gave very good results both in regard to correction and maintenance. There were no untoward complications. He believes that the results might be still more gratifying in spastic cases.—*A. Steindler, M.D., Iowa City, Iowa.*

THE RESULTS OF A NEW OPERATION FOR THE SUBSTITUTION OF A THUMB. J. Leonard Joyce. *British J. Surg.*, XVI, 362, Jan. 1929.

The author reviews the methods employed in the reconstruction of a mutilated thumb as follows:

1. Methods entailing the transplantation of tissue from a distance.
   a. Pedicle graft of skin, tubed and stiffened by a free bone graft.
   b. Transplantation of a toe.
   c. Transplantation of ring finger of opposite hand.
2. Methods using the remaining parts of the injured hand.
   a. Making a cleft between first and second, or second and third metacarpal bones—the phalangization method.
   b. Finger transplantation.
   c. Rotation of two of the remaining fingers.
   d. A combination of two or more of the above methods.

The author presents two cases in which he substituted the ring finger of the opposite hand for a thumb. In the first case which was reported ten years ago, the substituted ring finger was articulated with the trapezium; the interphalangeal joints were arthrodesed because of contractures during the first three years—and for the past seven years the patient has possessed a thumb ankylosed in hyperextension at the interphalangeal joint, slight flexion at the metacarpophalangeal joint, but having a complete range of normal motion at the carpometacarpal joint. The patient uses his thumb naturally.

In Case 2 the author did the same operation except that the transplanted finger was articulated with the styloid process of the radius. The aim of the operation—that is, the provision of a fixed sensitive thumb to which he could appose the remaining fingers of his hand—was not fully realized, owing to an initial error in technique whereby the finger was transplanted with its transverse plane nearly parallel to that of the palm of the hand instead of at right angles to it.

A complete bibliography is appended.—*L. J. Miltner, M.D., Iowa City, Iowa.*

FRACTURES OF THE PELVIS: An Analysis of 100 Cases. Cecil P. G. Wakely. *British J. Surg.*, XVII, 22, July 1929.

The majority of cases cited were due to motor accidents. Visceral complications were present in but eleven instances. The anterior half of the bony pelvis is weaker than the posterior half. The strength of the lateral and posterior pelvis lies in the thickened portion of the hip bone, extending from the auricular surface to the acetabulum and to the peculiar inner structure of the bone.

I. Fractures of the Whole Pelvic Girdle (44) are divided into two types. In the first the structure is oblique in nature, causing a solution in continuity of the pubic rami on one side, and an irregular fracture of the sacrum and posterior iliac crest on the other. The cause of such fractures is usually a "run-over" accident. In the second type the fracture is limited to one side and is usually due to being caught between two railway cars.

Shock is usually present and rupture of the rectum, bladder, and urethra may be present. Prompt treatment is essential, catheterization should be done and any rent in the urethra should be repaired over a catheter. The writer fixes the pelvis by a broad binder and after ten days applies plaster breeches, which he removes six weeks later. Walking with crutches is allowed after nine weeks. In case of doubt as to a rupture of the bladder, the abdomen should be opened.

In this group of 44 cases there were visceral complications in six. The number of deaths, if any, is not stated. No end results are given.

II. Fracture of the Ilium (18). These were all due to direct trauma and there were no visceral complications.

III. Fracture of the Pubis or of the Pubic Rami (24). Sixteen were due to vehicles, four to crushes, and four to falls. There were three ruptures of the urethra, and two extraperitoneal ruptures of the bladder.

The treatment given in these two groups is the same as in the first. End results are not noted.

IV. Fracture of the Ischium (5). These were all due to falls on the buttocks. Treatment consisted of rest in bed for six weeks, then massage for two weeks during which time the patient was allowed to get up. "Union was good in every instance and there was no disability whatever."

V. Fracture of the Acetabulum (2). One case was that of a dislocated hip with a fragment off the posterior tip of the acetabulum. The other was a stellate fracture in a child. There was no disability in either instance.

VI. Fracture of the Sacrum (4). These were due to direct violence. Treatment was the same as in the first three groups.

VII. Fracture of the Coccyx (3). Treatment was by rest in bed; operative removal of the fragment was done in two cases.

RADIOGRAPHIC FINDINGS IN 347 PAINFUL SHOULDERS. James F. Brailsford. *British Med. J.*, I, 290, Feb. 16, 1929.

The author examined the radiographs of 347 patients who complained of pain in the shoulder. Recent injuries of the shoulder were not included in the series. The following classification was made:

Normal	177
Arthritic changes of acromioclavicular joint	51
Arthritis of shoulder joint	24
Loose body	11
Old fracture	24
Dislocation of shoulder joint	4
Tuberculosis	29
Cyst of the humerus	2
Carcinoma	2
Sarcoma	4

Myeloma	2
Exostosis	2
Osteomyelitis with arthritis	7

No cases of osteochondromatosis were observed.—*E. M. Cowart, M.D., Iowa City, Iowa.*

LONGITUDINAL OSTEOTOMY. S. L. Haas. *J. Am. Med. Assn.*, XCII, 1656, May 18, 1929.

A method of producing an osteotomy for a bending or rotation change has been followed in an endeavor to secure better bone contact and prevent subsequent displacement.

The operation consists in exposing the bone subperiosteally and making five or six longitudinal cuts, three or four centimeters in length, with an osteotome and then molding the bone in any desired position.

The bones in children only have been operated on and results have been uniformly good.—*W. B. Carrell, M.D., Dallas, Texas.*

ABSCESSES IN TUBERCULOSIS OF THE SPINE. J. W. Sever. *J. Am. Med. Assn.*, XCII, 1822, June 1, 1929.

In a study of one hundred cases of Pott's disease, it was found that frank roentgenographic evidence of abscesses occurred in twenty-nine per cent. Most cases show perivertebral thickening, which should be interpreted as a small abscess. The size and shape of abscesses vary, and are dependent on restricting ligaments and muscles.

In the upper thoracic region the abscess tends to point upward; in the lower thoracic the diaphragm checks downward extension and they frequently point on the back.

Abscesses confined by ligaments against the vertebral bodies may, from pressure erosion, produce a new focus in one or more vertebrae. Conversely, direct involvement of an adjacent vertebra may produce a new abscess against its body and sustain an erosion, giving the same appearance as if it had been infected by the wandering abscess.

Calcifaction in abscesses occurs late and indicates healing.

A closer study should be made for the perivertebral thickening shown in roentgenograms, which is an indication of abscess formation, even though signs of erosion may be absent.—*W. B. Carrell, M.D., Dallas, Texas.*

UPWARD DISLOCATION OF ACROMIAL END OF CLAVICLE: Treatment by Elastic Traction Splint. C. M. Shaar. *J. Am. Med. Assn.*, XCII, 2083, June 22, 1929.

The author reports six cases, with satisfactory results in five, all treated by maintaining an elastic pressure on the outer end of the clavicle for four weeks. All the cases were of the less severe type, with injury probably limited to the acromioclavicular ligament. One failure in the group had subsequently an operation, with complete relief.

The device illustrated is essentially a canvas strap, crossing the clavicle, to each end of which is attached rubber tubing and the latter anchored to a band of webbing laced around the flexed forearm and chest.—*W. B. Carrell, M.D., Dallas, Texas.*

POLYARTHRITIS: Further Studies on the Effects of Sympathetic Ganglionectomy and Ramisectomy. Leonard G. Rowntree and Alfred W. Adson. *J. Am. Med. Assn.*, XCIII, 179, July 20, 1929.

In March 1927, a report was made of the early results from lumbar ramisectomy on a case of severe multiple arthritis. On observation in October 1928, there was so much improvement that ganglionectomy was done for relief of symptoms in the upper extremities.

The patient, a young woman, stenographer, had been hopelessly ill for six years with progressive changes in all extremities from arthritis deformans, the joints swollen, contractions present, skin shiny, nails brittle, cold, clammy extremities, bathed in sweat, with tenderness and pain on motion. Bilateral ganglionectomy was done in June 1926, with immediate and complete relief of symptoms in both legs. In October 1928, she returned with practically normal function in lower extremities. The skin

was warm and dry, motion free and painless, but some crepitation, partciularly in knees, and no appreciable change in roentgenograms before operation and two and one-half years later. During this period of freedom from symptoms in the lower extremities there had been progressive increase in the involvement throughout the joints of the upper extremities.

In November 1928, a bilateral cervicodorsal ganglionectomy was done, and immediately the hands became warm and dry, the capillary circulation improved, and early relief from the pain and stiffness incident to the arthritis followed.

There were some minor complications from this operation, but the general improvement was satisfactory, though there was occasional return of arthritic pains in wrists and elbows four months after operation.

Complications incident to the cervicodorsal operation were Horner's syndrome, tachycardia, elevation of blood pressure, and disturbance to the sweating mechanism. Five months after operation Horner's syndrome persisted, but the blood pressure was normal in all extremities and the patient comfortable and happy.—*W. B. Carrell, M.D., Dallas, Texas.*

Le Traitement opératoire des Fractures sous-thalamiques du Calcanéum. P. Wilmoth et P. Lecoeur. *J. Chir.*, XXXIII, 781, June 1929.

The authors discuss the poor results which frequently follow fractures of the os calcis, and think that many are due to the internal architecture of the bone which is rather delicate and spongy in nature between the body of the bone and the posterior tuberosity. This delicate bone is compressed when the bone is fractured, and the authors believe that in order to restore the normal contour it is necessary to fill in the gap caused by the concussion of bone. They discuss other late inventions, including section of the tendon of Achilles which was first done in 1902 by Carless, and subastragaloid arthrodesis which was reported in 1911 by Van Stockum.

The authors' operation is as follows: A long curved incision is made on the lateral side of the leg beginning over the fibula about ten centimeters above the tip of the malleolus and curved downward, behind, and over the malleolus along the lateral border of the foot to the base of the fifth metatarsal. The perineal tendons are freed by cutting their retaining ligaments and are then retracted anteriorly. Then the lateral surface of the os calcis is completely freed. The contour of the bone is restored by carefully lifting the superior articular surface up into its normal position and pushing the posterior tuberosity back and down. This leaves a gap of about one centimeter in the bone which the authors claim is due to the compression of the delicate bony trabeculae. This space is then filled with osteoperiosteal grafts which are taken either from the lateral surface of the external malleolus and fibula or from the mesial surface of the tibia. This increases the height of the calcaneus but not quite to normal. If the anterior end of the bone is completely detached, one can also arthrodese the calcaneocuboid joint at the same time. The perineal tendons are then replaced and the ligaments sutured over them. The skin is closed, a plaster cast is applied after the wound is healed and the stitches are removed.

Four cases are reported, but nothing is said as to the ultimate function.—*J. A. Key, M.D., St. Louis, Mo.*

Tonsillectomy in Chronic Arthritis: Report of 200 Cases carried out at Royal Bath Hospital, Harrogate. A. B. Pavey-Smith. *Lancet*, I, 170, Jan. 26, 1929.

The author studied 200 cases of arthritis in which he had done tonsillectomy. Questionnaires were sent out and 172 replied. The time that had elapsed following the operations varied from three months to six years. Thirty-five were cured and ninety-nine were improved, a total of seventy-eight per cent. good results; twenty-one were unchanged and seventeen were worse. The percentages cured and improved under the various categories are:

Subacute rheumatism	93 per cent.
Infectious arthritis where focus was located	82 per cent.

Infective arthritis where focus was not located	50 per cent.
Fibrositis	71 per cent.
Neuritis	33½ per cent.
Cases with duration less than one year	85 per cent.
Cases with duration more than five years	73 per cent.
Cases with history of tonsillitis	91 per cent.
Cases with no history of tonsillitis	64 per cent.

—E. M. Cowart, M.D., Iowa City, Iowa.

FRACTURE OF THE END PHALANX FROM TEAR OF THE EXTENSOR TENDONS AT POINT OF INSERTION. Antonio Menses. *Lisboa Medica*, V, 12, 1928.

Today this lesion is not considered very rare, although Selberg in 1908, investigating the enormous clinical material of Hoffa, found only a single case. In this condition we may have to deal with a fracture of the base of the phalanx, or a tear of the extensor tendon at its point of insertion, or a tear of the tendon at some distance from the point of insertion. Anatomical situation favors the occurrence of a tear fracture, as this may occur by comparatively insignificant forces; from the anatomical situation it would appear strange that this condition is not found more frequently. Almost always it results from a brisk force which is often insignificant in degree; not infrequently it is found in sport injuries,—for instance, skaters, horsemen, boxers, etc. The case described by the author concerned a woman who received her injury by a fall upon the extended fingers. She contracted a fracture of the base of the end phalanx of the right middle finger. The symptoms were swelling of the articulation, pain, and impossibility to actively extend the phalanx beyond an angle of about forty-five degrees. The x-ray confirmed the diagnosis of a tear fracture of the extensor tendon.

In the treatment the author follows the suggestion of earlier observers, especially that of Zuppinger and Cramer. These surgeons used splints which held the finger in extension. Schwartz uses a continuous fixed extension applied from the tip of the finger to the wrist. Bonneau prefers plaster-of-Paris fixation. Klapp and Manasse advocate surgical intervention in the form of primary suture of the severed tendon.

The author believes that surgical intervention is unnecessary in these cases if they are well treated from the very beginning. The appliance used by the author was one described by Ziemacki in which the finger is held in hyperextension by an apparatus or an adhesive strip which is applied as follows:

A strip is laid first at the volar surface of the end phalanx, passes over the tip of the finger and then crosses the finger in strong hyperextension in all joints; the strip is fastened to the wrist.

The after-treatment in the case of the author was instituted after three weeks, when the strip was removed. This treatment consisted of mobilization and massage. Complete cure was acomplished.

The observations of the author confirm the existence of a tear fracture of the base of the phalanx, and demonstrate the extraordinary importance of radiography in all kinds of finger lesions. Complete cure can be accomplished by conservative measures.
—A. Steindler, M.D., Iowa City, Iowa.

ENQUÊTE AUPRÈS DES JOUERS DE FOOTBALL OPERÉS POUR UNE LÉSION D'UN MÉNISQUE DU GENOU (Inquiry concerning Football Players operated upon for Lesion of a Meniscus of the Knee). Tavernier et Chappoux. *Presse Méd.*, XXXVII, 179, Feb. 6, 1929.

Forty football players are known by the authors but only twenty-one histories are acceptable.

They were operated on by different surgeons following different techniques.

In nineteen, results are excellent. Eighteen are playing again and as well as before; the other one does not play any more for personal reasons.

In two cases the results are poor: the first one was operated on by transpatellar incision. The authors do not like this kind of incision and prefer the technique of transversal incision, section of lateral ligament and resection of the meniscus *in toto*. The second case with poor result shows a laxity of the lateral ligament, and the authors recommend making a suture of this ligament, the knee being in slight flexion and in varum.

The time of healing is between two and twelve months.—*D. R. Soeur, M.D.* (Brussels), *Iowa City, Iowa.*

MOYENS D'ACTIVER LA FORMATION DU CAL DANS LES FRACTURES OSSEUSES (To Urge the Formation of Callus in Fracture of Bone). K. Glaessner et J. Hass. *Presse Méd.*, XXXVII, 176, Feb. 6, 1929.

After a short history of the question of callus and endocrinology, the authors give the result of their experimental work with thymus glands.

Two series of cats were taken. Legs were fractured and thymus removed in both series. X-rays were taken. Then thymus gland was given to the first series only. After four weeks all the animals were sacrificed. The callus in the series that received thymus gland was definitely better then the callus of the other series.

The authors chose cases apparently equal, like osteotomy, and gave thymus gland in one case and nothing in the other; after three months the callus of the patient who received thymus was good, and in the other case very slight.

The authors now prescribe thymus gland in any case of fracture.—*D. R. Soeur, M.D.* (Brussels), *Iowa City, Iowa.*

FRACTURES OF THE PELVIS. W. H. Gilmore. *Radiology*, XII, 345, Apr. 1929.

In this extremely valuable paper, the author presents seventeen cases of severe fractures of the pelvis, with roentgenograms, and history of the outcome, period of disability, and final amount of permanent disability.

There was surprisingly little permanent disability even though many of the cases had marked deformity in the final union. All but one of the patients were men. Nearly all returned to their former occupations in the coal mines, and regained their former earning ability after settlement of their claims.

The series seems to show the impossibility of determining degree of disability from x-ray findings.—*Edward N. Reed, M.D., Santa Monica, Calif.*

INTRAPELVIC PROTRUSION OF THE ACETABULUM. Howard P. Doub. *Radiology*, XII, 369, May 1929.

This article presents eight cases of an uncommon hip condition characterized by deepening of the acetabular cavity and inward protrusion of its mesial wall. With this there is limitation of abduction, rotation, and frequently of flexion and extension; and a complaint of pain, usually in the low back; and a peculiar gait.

Opinion is divided as to the etiology. Osteo-arthritis is the most constant accompaniment and may be confined to the acetabulum, without involvement of the femoral head, or may perhaps cause absorption of the acetabular floor, with reaction on the pelvic side, causing the laying down of new bone. A process similar to Legg-Perthes' disease, but involving the acetabulum and not the femoral head, may be the cause. Of the eight cases presented, seven were females; the age incidence was from sixteen to fifty-five; all had negative Wassermanns; and it was not possible definitely to link up the condition with previous infection or trauma. The duration of symptoms varied from one to seven years with an average of three and one-half years.

The author feels that the condition is best explained by some general disease in early life, causing softening of the bones with deformity, the osteo-arthritis appearing as a later stage in the process.

Radiograms of all the cases are reproduced. These show a deepening of the acetabulum, with thinning of the mesial and inferior wall, with considerable eburnation. Frequently there is absorption of the cartilage, with narrowing of the joint space.—*Edward N. Reed, M.D., Santa Monica, Calif.*

OSGOOD-SCHLATTER'S DISEASE. Robert B. Taft. *Radiology*, XII, 414, May 1929.

The author reports eight new cases, and one old one. He believes the disease much more common than the number of reported cases would seem to indicate. It is far more frequent in boys. Being an epiphysitis, it can begin only between the time of appearance of the epiphysis and of its final union with the tibia,—*viz.*, between the ages of twelve and twenty-one.

There is usually the history of a slight injury, followed by continuous and severe pain, extreme tenderness, and some swelling, redness, and local heat.

The etiology is unknown, and the author states that the pathology is likewise unknown, no record being found of any microscopic study. He believes that the condition is purely traumatic in origin, although the trauma is often slight.

A case studied radiographically seventeen years after its onset showed marked increase of bone production at the site of the old lesion.

In most cases simple splinting is efficient treatment. In some, a curettage of the tubercle or a bone peg, to anchor the patellar ligament, has been necessary.—*Edward N. Reed, M.D., Santa Monica, Calif.*

GENERALIZED OSTEITIS FIBROSA. I. Seth Hirsch. *Radiology*, XII, 505 and XIII, 44, June and July 1929.

Osteitis fibrosa is a disease with polymorphous manifestations. Leontiasis ossea, the cyst, the giant-cell tumor, and simple fibro-osteoid changes, any or all may occur in a generalized osteitis fibrosa.

X-ray examination permits study of various stages in the same individual. Raget called the disease osteitis deformans; von Recklinghausen, osteitis fibrosa. The latter grouped osteitis deformans and osteitis fibrosa with rickets, and osteomalacia under the general heading of malacia, and also included osteogenesis imperfecta. The distinction between these is a relative and not a specific one.

In all, there is softening, produced by resorption, and substitution of fibro-osteoid tissue, the end result depending upon the nature and intensity of the reconstructive effort. Typical Paget's is a disease of late life; von Recklinghausen's of early life; but no hard and fast line can be drawn between them. The lesions may involve part of a bone, an entire bone, or several bones.

The roentgen differentiation between a giant-cell tumor and a true sarcoma is frequently impossible. Involvement of the bones of the hands and feet, especially in the first three metacarpals, occurs in nearly every case. The lesions are usually small but distinctive.

While the age of incidence of Paget's disease is usually the third or fourth decade of life, numerous cases in the second decade have been reported. The disease develops very slowly and subjective symptoms appear comparatively late in its course. The early stages have few or no subjective symptoms.

The evidence from the cases reported by the author and from numerous cases in the literature points to the frequent commencement of the disease in childhood, at times in its very early years. There seems to be a strong hereditary factor in many cases. The changes occurring in childhood are not the typical hyperostotic metaplastic malacia seen in adults, but the hyperplastic types of malacia.

The author reports: (1) a case studied by radiograms over a period of sixteen years; (2) three children of the same family showing the early stages of the disease; (3) a case showing an association of metaplastic and hyperplastic malacia, studied in several hospitals over a period of years, the hyperplastic process manifesting itself by an excess of new subperiosteal bone production in irregular longitudinal bands, and the metaplastic

process by the bone expansion, cyst formation and by the malacia; (4) a case of cystic metaplastic malacia with hyperostotic changes, in an infant; (5) a case of cyst and tumor forming metaplastic malacia in a female aged twenty-two years; and (6) two cases of cystic metaplastic malacia of the von Mikulicz type.

The author concludes that the period of onset of generalized osteitis fibrosa has been brought back to the earliest period of life; that the various phases give definite roentgen findings; that it is justifiable to infer that there are marked hereditary tendencies, and that these are congenital hereditary diseases.

The article contains sixty-eight fine illustrations, reproductions of photographs and radiographs.—*Edward N. Reed, M.D., Santa Monica, Calif.*

LES ABCÈS CHRONIQUES PRIMITIFS DES OS (Primary Chronic Abscess of the Bones). Jean Piquet and G. Cyssau. *Rev. d. Chir.*, LXVI, No. 8, 594, and No. 9, 647, 1928.

Brodie, in 1830, described for the first time this abscess of the bones. But afterwards the name was very often employed by mistake in cases of acute or subacute osteomyelitis with abscess under the periosteum and destruction of bone in the diaphysis.

This paper considers the primary abscess of bone being the only symptom of the disease, or coming after an osteomyelitis whose focus is situated in any other bone. These abscesses are very rare and the literature reports only fifty cases with bateriological proofs. The other cases are tuberculosis, acute osteomyelitis, mycosis, syphilis, etc.

Etiology.

Trauma seems to be sometimes an accidental cause but, in reality, no scientific proof exists. The primary focus of the infection is generally unknown and this is explained by the fact that the abscess of the bone is chronic and the evolution very slow. The bacilli found are, in order of importance: staphylococcus aureus, Eberth's bacillus, streptococcus coli bacillus, pneumotyphoid A and B.

Anatomy—Pathology.

Tibia and femur are the bones in which the abscess is most frequent. The abscess is sometimes in the bulba near the cartilage, but this is not the rule; the abscess may appear in the diaphysis, never in the epiphysis, but it may involve secondarily the epiphysis, rarely the joint. In general the abscess is unique. The shape and size are variable and in some cases without real cavity (Henderson).

The pus has the typical characteristics of this kind of bacillus. Sequestra are not infrequent. The membrane of the abscess is made up of red granulations that are always present. These granulations consist of fibrous tissue with new vessels and white blood cells. The wall of the abscess is not always an osteitis with bony condensation, as Brodie and the classical school believe, but sometimes osteitis of a rarefying type.

It is of importance to know the relation between the granulation tissue of the membrane and the density of the bone,—many granulations, no change of the bone; few granulations, sclerosis of the bone. It seems too that the big abscesses have a tender wall with granulations on the membrane; small abscesses have a hard, sclerotic wall and few granulations. Changes of the periosteum and new formation of bone are usual.

Pathogenesis.

The formation of the abscess of the bone is probably the same as that of the foci of osteomyelitis. We know that in acute osteomyelitis the bacilli involve the living tissue of the bone, *i.e.*, the marrow. But by this name—marrow—we must understand not only the tissue of the central cavity but also the osteogenetic cells under the periosteum and connecting the tissue of the haversian canals. Osteomyelitis is not a disease of the central tissue of bone but a disease of the living part of the bone, of the spongiosa tissue. Abscesses of bone are from the same origin but the areas are more definite, the rest of the spongiosa tissue is normal. And so the first lesion is a focus of rarefying osteitis.

The necrosis may be explained in two different ways:

1. Vessels are compressed, blood is insufficient, and the bone necroses.

2. Or, with Leriche and Policard, we may believe that necrosis results from increase of circulation which provokes a resorption of bone.

Evolution possible.

1. Sclerosis: abscess does not always involve the bone but sometimes healing is obtained spontaneously by sclerotic evolution; the abscess is progressively filled with bone, and this appears in the cases where the circulatory decrease and granulations are not very numerous.

2. Periostosis in progression.

3. Rarefying osteitis involves the bone and also the abscess grows and grows. This appears in cases in which granulations are abundant and where white cells are not very abundant.

4. Formation of cyst. This question is very difficult, and the authors give a review of the theories of the etiology of the cysts of the bones and they conclude that the abscess of bone may in some cases, after sterilization, give a real cyst. But they do not admit, with Bloodgood and some others, the idea that the cysts of the bone are always of inflammatory origin and the result of an old osteomyelitis.

Clinical Symptoms.

Onset is quiet, acute pain and trauma may be present; fever and local temperature. Very often the initial pain disappears after a few days and recurs often but is dull, indefinite, slight. In some of the cases which the authors present the pain did not exist and the disease was not known by the patients.

After the onset, gradually the pains increase and after awhile present a new character: sharp pain during the night time, dull pain or none during the day time. So Brodie's abscesses were often treated like syphilis and the treatment seemed to increase the pains. Objectively tumefaction is present but without infiltration of the soft tissues. Palpation shows a hard irregular tumor, the character of tenderness of the bone is also very important. Usually the abscesses respect the joints. Fever is nil or of few degrees. General condition good.

Variations.

The form previously described is the typical one but we may have:

1. Subacute abscesses of bone that are really the transition between acute osteomyelitis and chronic abscesses.

2. Torpid abscesses quite without symptoms.

3. Abscesses like cysts. Eight cases are reported in the literature of bony cysts, in which diagnosis was made with clinical, x-ray, and operative findings, in which pus and microbes were present, and of course these are in favor of the inflammatory theory of cyst formation.

Evolution.

It is essentially chronic, with no involvement for many years (nineteen years in one history). The patient comes to the surgeon not on account of the abscess but on account of pain.

X-ray and Diagnosis.

X-ray findings are very different in the various types and may simulate many other diseases.

1. A white area in good bone. May be confused with the myeloma but this tumor is, in general, multiple; with syphilitic gumma or hereditary syphilis; with central sarcoma, but the shadow of this is less definite; with certain types of tuberculous lesions, but here pain is little, no pain during the night time, tendency to involve the tissues.

2. Central abscess surrounded by a thick ivory bone, with or without periostitis. May be confused with abscesses following osteomyelitis.

3. Central area indefinite, with periostitis. Confused with osteosarcoma, but here periostitis is less marked; with osteosarcoma of periosteum origin; with hyperosseous type of syphilis; with tuberculosis of the diaphysis.

4. Abscess with distension of the cortex and aspect of puffed bone. Confused with chondroma, but this tumor is usually located in the pelvis or the fingers and chronic abscesses are principally found in long bones; with essential bony cysts,—differential diagnosis impossible; with echinococcus cysts, but those are multilocular; with syphilis.

5. Sclerosis without any cavity.

Differential diagnosis impossible; confused with syphilis, chronic sclerosing osteitis (of Henderson), and osteosarcoma.

Treatment.

The authors discuss all the different kinds of treatment from the simple drainage to the filling of the cavity with lead (technique of Mosetig), with a fat graft (Chaffut), with muscle graft, and bone graft. They discuss also the direct closure of the wound and vaccine.

Conclusions are:

1. In cases where evolution is subacute, to trephine the bone, curettage until the bone is bleeding, and use flat dressings. Disinfection of the cavity with antiseptics does not seem to give any result.

2. In cases without general symptoms, essentially torpid, after a few days of drainage and Dakin irrigation, a muscular or osteoperiostic graft may be used.

Observations.

A résumé of all the histories reported in the literature are given.—*Robert Soeur, M.D.,* (Brussels), *Iowa City, Iowa.*

MANAGEMENT OF GONORRHEAL ARTHRITIS. J. A. Key. *Southern Med. J.*, XXII, 469, May 1929.

The author reports obtaining gram negative cocci in cultures from thirteen of the last sixteen cases. He describes the pathology of these joints. The treatment should be general, to increase the resistance of the patient. Adequate nutrition, forced fluids, increased elimination, and rest relieve pain. The primary focus should be treated by a specialist in genito-urinary conditions. Gonococcic vaccines are used for about two weeks. Injection of foreign protein sometimes gives good results. Intravenous injections of mercurochrome and other antiseptics have been tried with variable results. Amidoxyl intravenously gave good results in two mild cases.

Local treatment: a plaster cast, bivalved so it can be removed and replaced, or some form of brace or traction is used. This gives rest and relief of pain and also, which is extremely important, prevents deformity. In cases which become ankylosed the joint must be kept in the position best suited for good function. Local heat, baking, and diathermy give some relief; massage should be extremely gentle, if used at all. Motion is postponed until acute symptoms subside. In severe cases in knees arthrotomy, thorough irrigation, and closure plaster cast for about ten days, followed by physiotherapy, gives good results if the cases are seen early. The Williams method of arthrotomy, drainage, active mobilization of the joint every two hours night and day, has given good results in some of the severe suppurating cases. Convalescent stage is treated by physiotherapy. Cases with fibrous ankylosis in poor position may be helped by manipulation under anaesthesia and the joint fixed in the best position for function. The range of motion in the joint can be improved by manipulation. If bony ankylosis has occurred, an arthroplasty is the operation of choice.—*Fred G. Hodgson, M.D., Atlanta, Ga.*

ACUTE OSTEOMYELITIS AND COMPLICATIONS. N. D. Bitting. *Southern Med. J.*, XXII, 580, June 1929.

Etiology, pathology, sign and symptoms, diagnosis, and treatment are briefly discussed. Early incision and drainage are recommended. Repeated transfusions are used in cases of severe bacteraemia.—*Fred G. Hodgson, M.D., Atlanta, Ga.*

TREATMENT AND MANAGEMENT OF FRACTURES OF THE HIP IN OLD PEOPLE. Lawson Thornton. *Southern Med. J.*, XXII, 590, June 1929.

The author uses a double spica plaster cast extending from a point just below the costal margins to the toes of both feet; a brace made of plaster-covered wooden bars

spans the space above the ankles to complete the triangle and strengthen the cast. A hypodermic of one-sixth to one-third grains of pantopon is given; no other anaesthetic is used. Some form of traction fracture table is essential. Stockinette is used next the skin and bony prominences are protected. The good leg is set parallel with the mid-line of the body, the fractured leg in the Whitman position, abduction and internal rotation. The advantages are: (1) better immobilization; (2) easy change of position, back, side, or abdomen; (3) fixes the pelvis and leaves the chest free; (4) buttocks and thighs support weight and relieve pressure on lower back. Two nurses are essential for proper care. At the end of ten weeks cast is bivalved. If union is firm it is left off. After four more weeks in bed the patient begins to walk with crutches.—*Fred G. Hodgson, M.D., Atlanta, Ga.*

Applied Anatomy of the Back in Relation to Injury. R. W. Billington and R. S. Cunningham. *Southern Med. J.*, XXII, 643, July 1929.

This is a general consideration of the various causes and symptoms in back injuries. An attempt is made to explain many of these conditions on an anatomical basis. There has been a great deal of discussion about low back pain and a great deal of speculation. A thorough knowledge of the anatomy of this region will help to throw light upon many of these obscure cases. The conditions selected for discussion are: (1) fractures, (2) dislocations and subluxations, (3) sprains, strains, and ligament ruptures, (4) muscle injuries, (5) hematomas, (6) traumatic arthritis and synovitis, (7) compression and contusion of the spinal cord and nerves. There are some excellent illustrations. This is an interesting attempt to determine the anatomical and pathological explanation of these manifestations.—*Fred G. Hodgson, M.D., Atlanta, Ga.*

The Importance of the Tibials in the Production and Recurrence of Club-feet. J. W. White. *Southern Med. J.*, XXII, 675, July 1929.

The author considers the tibialis posticus muscle the chief agent in causing a talipes equino varus. It is assisted by the tibialis anticus. He believes that the peroneal nerve, on account of its peculiarly exposed position, is traumatized in utero and the muscles supplied by it are weakened, while the internal popliteal nerve is well protected and the muscles supplied by it are active and their contraction causes the deformity. In correcting a club-foot in a young child, he removes a section of the tibialis posticus through an incision just behind the internal malleolus. Then the usual plaster correction is used. The method has not been used long enough to prove the author's theory.—*Fred G. Hodgson, M.D., Atlanta, Ga.*

Fractures of the Upper End of the Humerus. H. P. Mauck. *Southern Med. J.*, XXII, 712, Aug. 1929.

This is a report with classifications of 115 cases. Various methods of treatment were used. Some cases were treated by open operation, but no internal fixation was found necessary. No cases of non-union developed.—*Fred G. Hodgson, M.D., Atlanta, Ga.*

Fractures of the Spine. Hugh Thompson. *Southern Med. J.*, XXII, 682, July 1929.

The author believes more satisfactory results would be obtained by quicker and better operations rather than by increased conservatism. In compression fractures without paralysis, he advises recumbency for seventy-five to ninety days, followed by a spinal corset or brace. Spine fusion operations are reserved for those cases which do not recover under conservative treatment.—*Fred G. Hodgson, M.D., Atlanta, Ga.*

ORTHOPAEDIC MANIFESTATIONS OF INTRA-PELVIC DISEASES. I. Wm. Nachlas. *Southern Med. J.*, XXII, 807, Sept. 1929.

Patients with low back pain often come to the orthopaedic surgeon. The following intrapelvic conditions must be considered: genito-urinary condition; gynaecological conditions; retroperitoneal abscesses; early malignancies. Because of his special training, the orthopaedist is best equipped to make the early diagnosis of retroperitoneal abscesses and tumors.—*Fred G. Hodgson, M.D., Atlanta, Ga.*

CHORDOMA. A REPORT OF TWO CASES: A MALIGNANT SACROCOCCYGEAL CHORDOMA AND A CHORDOMA OF THE DORSAL SPINE. Andrew J. Hutton and Archibald Young. *Surg. Gynec. Obstet.*, XLVIII, 333, Mar. 1929.

The interesting feature is the presence of chordoma in the dorsal spine, of which no record of a similar case could be found in the literature. They agree with Prof. Stewart's conclusions, that the chordoma is a tumor arising from relics of the notochord and is met with chiefly in the neighborhood of the spheno-occipital synchondrosis and in the sacrococcygeal region. Both simple and malignant forms occur, the latter being much more common. Even the malignant varieties are usually of slow growth and long continued course, especially those occurring in the sacrococcygeal region. They tend to recur after removal, and cause death chiefly by their local effect, dissemination being quite exceptional.

Intracranial tumors, by virtue of their position, are much more serious than sacrococcygeal, their average duration, from the first onset of symptoms, being about two years, as compared with nine years in the latter group.

The histological characteristics are distinctive. The tumor is alveolar in structure, and the parenchyma, usually of epithelial type, is composed of cells which become the seat of mucoid degeneration at a very early stage of their development. The mucoid change ultimately progresses to an extreme degree, and is comparable to that seen in the nucleus pulposus of an intervertebral disc. In malignant cases the nuclei show great variation in size and in depth of staining, and nuclear vacuolation may be present. —*Harry Goldberg, M.D., Iowa City, Iowa.*

MALIGNANT BONE TUMORS. Vittorio Putti. *Surg. Gynec. Obstet.*, XLVIII, 324, Mar. 1929.

It is the author's opinion that the problem of the skeleton, clinically considered, is first and foremost a problem of diagnosis. Early diagnosis is still the only certain way of ensuring a radical cure.

He believes the quotation of Murphy's still stands, that the diagnosis of sarcoma can and should be made by the history, and with the aid of skiagrams; he also believes that more than half the errors of diagnosis, and two-thirds of the delay in making a correct diagnosis, are due to inadequate attention to the history of the case, to incomplete examination of the patient, to delay in obtaining a skiagram, or the incorrect interpretation of it.

Trauma was a factor, which his histories revealed with great frequency as a cause of such tumors; forty-seven and sixteen one-hundredths per cent. of his cases showed this factor.

He accepts the premises of Segond, that isolated, direct trauma usually induced a tumor of the peripheral layers of bone with a short, latent period, whereas indirect trauma, open wounds, distortions, and fractures are causes of sarcomata with a long, latent period and a central situation.

In regard to symptoms, there are none specific. The peculiar quality of the pain should make one think of sarcoma. It is intense, dull, constant, and localized, but not accounted for by other local signs, however, in Ewing's tumor, there is an intermittent, spasmodic pain, associated with rise in temperature, suggestive of an inflammatory process.

In tumors of the pelvis and last lumbar vertebra, one may have pain which has all the characteristics of ordinary sciatica.

More important, in the author's opinion, than pain, is the location of the tumor. A tumor of the diaphysis is almost always an osteogenic sarcoma of periosteal type, or it is an endothelioma. A tumor of the metaphysis, if not benign, is sarcoma of central type; an epiphyseal tumor, in a great majority of cases, is a giant-cell tumor.

Tumors of the astragalus and os calcis are either giant-cell tumors or myxomata. A localized tumor of the vertebral column, unless it is secondary, is either an angio-endothelioma or giant-cell tumor.

Many tumors, in the author's estimation, that are regarded as primary, are none other than isolated metastases of visceral neoplasms.

The x-rays in certain cases may alone suffice for the diagnosis, while in many others, it forms only one part of it. The author deplores the fact that x-rays are not taken early from seats of unexplained pain, although this may be often the first and only symptom of a sarcoma.

He believes that the biopsy should be done only by an expert pathologist, and states that in a great majority of cases, biopsy is inadequate, since bone tumor tissue is never homogeneous.

In regard to endothelioma, he calls attention to the mooted question as to whether it is a primary or secondary tumor. He is inclined to believe it is secondary, due to its extreme sensitiveness to the x-ray, for it is known that the metastases of a bone tumor have a similar sensitiveness. He calls attention to a more recent investigation by Prof. Alessandra, which is daily gaining wider acceptance, that there exists carcinomatous and s[illegible]matous tumors of bone, which have originated from visceral blastomata, which can[illegible] be diagnosed clinically, and proven by postmortem examinations.

As to treatment, he has used radium therapy in association with surgical treatment and has utilized it as the only method in dealing with inoperable tumors. It has great value for relief of pain, especially in diffuse sarcomata. He has noted rapid disappearance of soft sarcomata, and more especially endothelioma with a few doses, but the disappearance is only temporary.

In osteogenic sarcoma he has had some success with tumors of the fibromatous type, but none with the periosteal, subperiosteal, or telangiectatic.

Giant-cell tumors he treats surgically, but he has observed relapses and occasional metastas[illegible] He is inclined to believe that Ewing's proposal, to treat them by radiation alone, is more logical.

His results of the treatment of bone sarcoma have been discouraging. His few successes represent cases treated with amputation or disarticulation.

The solution lies in more extensive research in the study of tumors and early recognition of the condition, and for one to have the courage of one's conviction to advise early radical measures.—*Harry Goldberg, M.D., Iowa City, Iowa.*

DEMONSTRATION DES PRÄPARATES EINER GEHEILTEN SCHENKELHALSFRAKTUR (Fracture of the Neck of the Femur). W. Anschütz. *Zentralbl. f. Chir.*, LV, 2876, 1928.

At the meeting of the Northwestern Society of Surgeons at Kiel, Anschütz, one of the most eager advocates of Whitman's treatment of the fracture of the neck of the femur, demonstrated a specimen of subcapital fracture in the neck of the femur. The patient was a woman seventy-three years of age who died three months after the fracture and one month after the removal of the plaster-of-Paris cast. The specimen shows an ideal position of the fragment with but a very slight shortening and a complete union. In the roentgen picture and at the saw cut, no trace of a fracture line is seen. Anschütz believes that the poor union in such cases is caused not by poor circulation or by the osteoporosis but solely by the bad position, and that by Whitman's method all such cases could be cured in good position and with good function.—*C. H. Bucholz, M.D., Halle, Germany.*

ZUR FRAGE DES OPERATIVEN FUNKTIONSERSATZES GELÄHMTER WADENMUSKELN (Substitution of the Paralyzed Muscles of the Calf). A. Jeletzki. *Zentralbl. f. Chir.*, LV, 2998, 1928.

In three cases of the paralyzed triceps of the lower leg, Jeletzki has substituted the power of that muscle by long strings of silk connecting the flexor muscles of the knee with the os calcis. The tendon of the long peroneus was implanted into the tendon of the anterior tibial. The results have been very satisfactory. A year after the operation the patient is able to wear normal shoes.—*C. H. Bucholz, M.D., Halle, Germany.*

DIE FUNKTIONELLE BEDEUTUNG DES LÄNGENAUSGLEICHES NACH BEINE (The Functional Importance of the Longitudinal Adjustment of the Legs). K. Deutschländer. *Ztschr. f. orthop. Chir.*, LI, 64, 1929.

Deutschländer thinks that the longitudinal adjustment of the legs is of very great importance for the functional development of the shorter leg, especially in cases of paralysis or other affections when the shorter leg is much thinner and weaker. The shorter leg is much more easily fatigued; the gait is uncertain; the patient has no endurance. Passive adjustment by an orthopaedic boot or a splint is never satisfactory, because the adjustment is only of a static value, but of no locomotive influence. Deutschländer prefers the shortening of the longer leg, at times even in several places. Thus in one case he removed a piece six centimeters long from the right femur and implanted one half of it into the gap between the ankylosed femur and tibia after loosening the arthrodesis. Finally, he removed a piece from the tibia and fibula, thus bringing the legs to almost equal length and improving the gait tremendously. The fact that the patients may wear normal shoes after the operation is of no little significance. Deutschländer has operated on seventy patients and is entirely satisfied with the results.—*C. H. Bucholz, M.D., Halle, Germany.*

SPONDYLITIS DEFORMANS UND TRAUMA (Spondylitis and Trauma). Gaugele. *Ztschr. f. orthop. Chir.*, LI, 74, 1929.

Gaugele has studied a great many roentgenograms of patients with fracture or other injuries of the spinal column and discusses the important question as to whether or not arthritis or spondylitis deformans may be caused by traumatism. He comes to the following conclusions: The origin of spondylitis deformans from traumatism has not yet been proved. It is entirely impossible that a slight trauma may cause such changes. Even after severe fractures in younger, as well as in older, persons the typical changes of spondylitis deformans generally are not seen. The development of the typical changes requires years and not weeks. But it may be acknowledged that the symptoms of the preexisting spondylitis, especially the pain, may be markedly aggravated by the trauma.—*C. H. Bucholz, M.D., Halle, Germany.*

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